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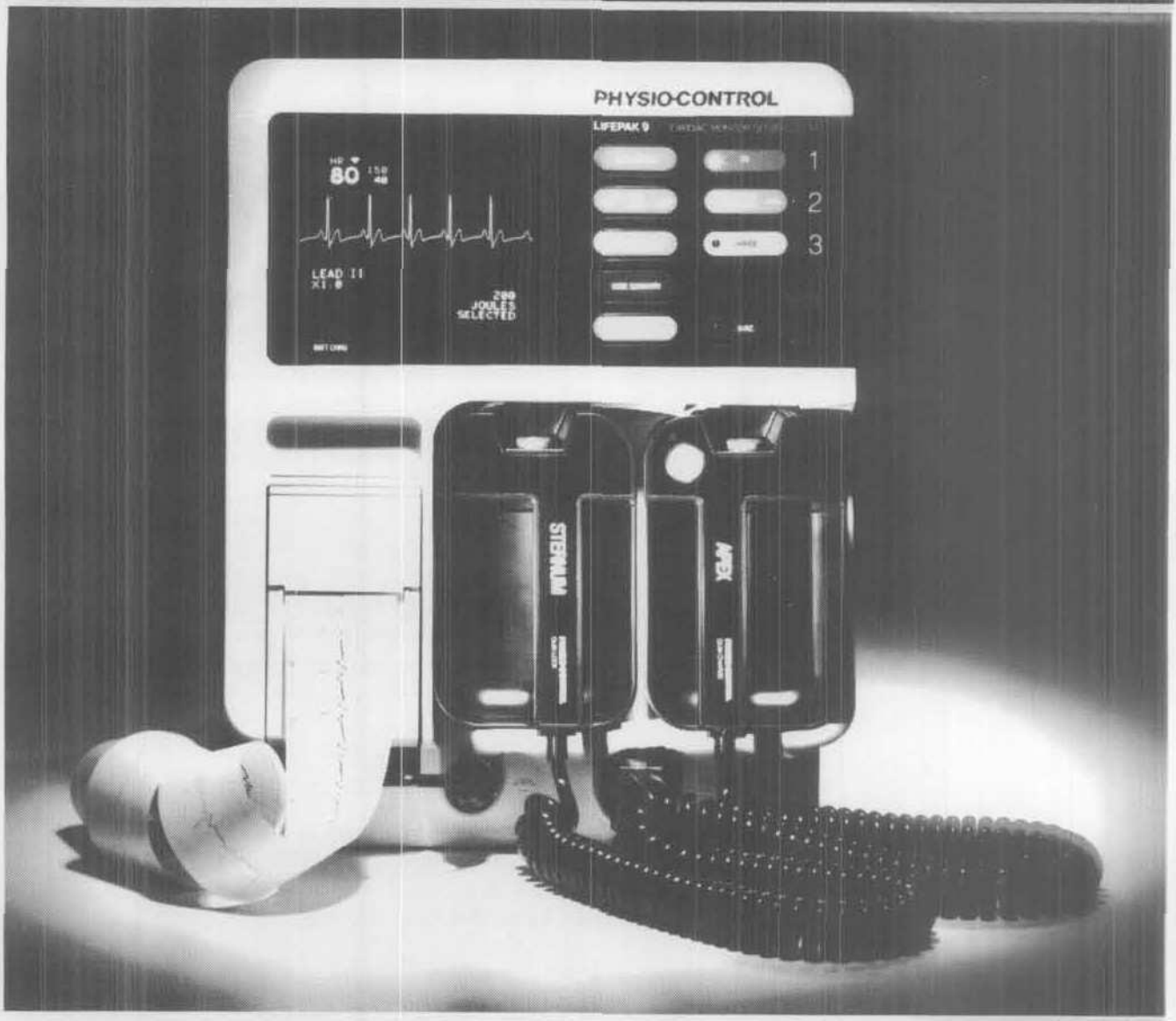
PHYSIO CONTROL

LIFEPAK® 9 defibrillator/monitor



Service Manual

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November 1991

Corporate Headquarters:
11811 Willows Road Northeast
Post Office Box 97006
Redmond, WA 98073–9706 USA
Telephone: 206/867–4000
Toll Free: 800/442–1142 or 800/426–8047
Telex: 990211 D PHYSIO RDMD
Telefax: 206/883–2988

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Safety Information

Introduction

This safety information includes terms and symbols used in this manual or on the equipment to alert both operating and service personnel of recommended precautions in care, use and handling of this specialized medical equipment.

Refer to NFPA 99–1984, **Health Care Facilities**, and NFPA 70–1987, **National Electrical Code** for specific guidelines on the standards and practices for health–care instruments and environments.

Terms

Certain terms are used in this manual, or on the equipment. Familiarize yourself with their definitions and significance.

Danger: Immediate hazards which **will** result in severe personal injury or death.

Warning: Hazards or unsafe practices which **could** result in severe personal injury or death.

Caution: Hazards or unsafe practices which **could** result in minor personal injury or significant product damage.

Note: Points of particular interest for more efficient or convenient instrument operation. Additional information or explanation concerning the subject under discussion.

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Warnings

Following are descriptions of general hazards and unsafe practices that could result in death, severe injury or product damage. Specific warnings and cautions not appearing in this section may be found throughout the manual.

Fire or Explosion Hazard

Do not operate this product in the presence of flammable gases or anesthetics. Explosion or fire can result. Refer to safety documents NFPA 99–1984, **Use of Inhalation Anesthetics (Flammable and Nonflammable)**, and NFPA 70–1987, **National Electrical Code** (Health Care Facilities section), before operating this product in the proximity of flammable gases or anesthetics.

Safety Hazard

Do not mount product directly above patient. Place the product in a location where it cannot harm the patient should it fall from its shelf or other mount.

Electrical Hazard

Do not operate equipment using damaged cables and wires. Broken or frayed wires, or loose snap fittings may cause interference or loss of signal. Perform frequent electrical and visual inspections on cables and wires. Pay particular attention to the point at which the wires enter the terminals. Repeated flexing at these points eventually causes the wire strands to break.

Shock or Fire Hazard

Do not immerse any portion of the instrument in water. Fluid spills and splashes may damage the instrument's electrical components.

Possible Equipment Damage

Do not sterilize this product. Sterilization environments can cause severe damage. Do not autoclave or gas sterilize accessories unless manufacturer instructions clearly approve it.

Safety Risk

Do not substitute accessories. Use only recommended accessories listed in Table 5–4 shown on page 5–5. Substitution may cause the instrument to work improperly.

Shock or Fire Hazard

Do not use unsafe equipment interconnections. It is extremely important that equipment interconnections be made in accordance with NFPA No. 70–1987 **National Electrical Code**, Article 517, Health Care Facilities. Compliance with articles 517–80 and 517–120 is especially important.

> *Note: Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. Check leakage current and grounding requirements after interconnecting this instrument with accessory equipment.*

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Symbols

Any or all of the following symbols may appear in this manual or on the equipment:

Static Sensitive Device (SSD)

Additional information in Section 6, Component Reference Diagrams

DANGER — high voltage present

ATTENTION — refer to manual for more information

Defibrillation protected, type CF patient connection

Defibrillation protected, type BF patient connection

Protective ground (earth) terminal

Fusible link

Equipotentiality connector

Off (Power: disconnection from the mains)

On (Power: connection to the AC mains)

ECG output

Recyclable battery

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General Information

Service Information

Before attempting to clean or repair any assembly in this instrument, the technician should be familiar with the information provided in Section 4, **Service and Maintenance**.

If the instrument has been dropped, damaged, or severely abused, a qualified technician should complete the **Performance Inspection Procedure (PIP)** in Section 3, beginning on page 3–12, to verify that all instrument functions are working properly.

Component replacement and internal adjustments must be made by service personnel qualified by appropriate training and experience.

The use of defibrillation electrodes and adapter devices from sources other than Physio–Control is not recommended. *If instrument failure is attributed to defibrillation electrodes not manufactured by Physio–Control, the warranty may be voided.*

If assistance in servicing the instrument is needed, contact Physio–Control at 1–800–442–1142.

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Effective Pages

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Configuration Information

This manual is current with the listed revision level of the following part numbers. The assemblies appear in the same order as in Table 5–1.

Assembly Name	Part Number	Rev
LIFEPAK 9 defibrillator/monitor	803800	D13
Main PCB Assembly	803715–11	B10
Power Supply PCB Assembly	803726–01	Orig4
Power Conversion PCB Assembly	803724–03	C15
Display Assembly	803706–00	Orig5
Interconnect PCB Assembly	803761–02	B3
Front Panel Assembly	803745–00	Orig8
Rear Panel Switch Membrane	803741–01	Orig3
Strip Chart Recorder Assembly	804189–00	P(GSI)
Transfer Relay Assembly	800240–11	R12
Paddle Assembly	802901–06	C2
Power Supply PCB/AC Receptacle/Ground Wire Harness	803783–18	A
Power Conversion PCB/Power SupplyPCB/Battery Wire Harness	803783–23	A
Battery Sensor/Power Supply PCB Wire Harness	803783–24	A
High Voltage Connector Cable Assembly	803756–13	C5
Main PCB/Monitor PCB Cable Assembly	803733–00	Orig
Main PCB/Recorder Cable Assembly	803773–00	Orig
Interconnect PCB/Front Panel Cable Assembly	803772–00	Orig2
Main PCB/Patient Connector Wire Harness	803783–00	A
AC Receptacle/Ground Wire Harness	803783–04	A
AC Receptacle Wire Harness	803783–05	A
Test Load Contact/Resistor Wire Harness	803783–06	A
Power Conversion PCB/Reed Assembly Wire Harness	803783–07	A
Power Conversion PCB/Dump Relay Wire Harness	803783–08	A
Power Conversion PCB/Charge Relay Negative Wire Harness	803783–09	A
Power Conversion PCB/Charge Relay Positive Wire Harness	803783–10	A
Main PCB/Sternum Relay Wire Harness	803783–11	A
Main PCB/Apex Relay Wire Harness	803783–12	A
Storage Capacitor Positive/Relay Wire Harness	803783–13	A
Storage Capacitor Negative/Relay Wire Harness	803783–14	A
ECG Out Wire Harness	803783–15	A

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Assembly Name	Part Number	Rev
Defibrillation Adapter	803747	A6
Test Load High Voltage Wire Harness	803774–03	Orig3
Test Load High Volage Wire Harness	803774–04	Orig3
Pushbutton Switch Wire Harness	803774–05	Orig3
High Voltage Connector Cable Assembly	803756–09	C5

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Overview

Physio-Control Corporation provides a service manual with each instrument. The following is a summary of the information contained in each section:

Section 1

Description: This section details how the instrument works. Input signals, power supplies, PCB functions, and instrument outputs are described. Each PCB circuit description is accompanied by a block diagram to illustrate the major circuits. Circuit names in these block diagrams also appear in the appropriate schematics in Section 5.

Section 2

Operation: This section familiarizes the user with basic equipment function. It identifies Controls, Indicators, and Connectors. This section is not intended to instruct the operator in the clinical use of the instrument; a separate *Operating Instructions* booklet is available for that purpose.

Section 3

Test and Calibration: This section contains Performance Inspection Procedures (PIP)— the sequential steps to follow when performing an operational closed–case check of the equipment. A PIP checklist is provided which can be duplicated and used during testing. Functional test and calibration instructions are also provided so a service technician can fully test and calibrate an instrument to the component or subassembly level using commonly available bench equipment.

Section 4

Service and Maintenance: This section provides Disassembly/Assembly Procedures for removing all major subassemblies in logical sequence. The procedures are referenced to numbered parts in the Final Assembly drawing in Section 5, Figure 5–1, located on page 5–13. This section includes instructions for inspecting, cleaning, maintaining, and repairing the instrument.

Section 5

Parts Lists and Schematics: This section contains Supplies and Accessories, Illustrated Parts Lists, PCB Component Layouts, and Schematic Diagrams for all repairable assemblies.

Section 6

Component Reference Diagrams: An aid to troubleshooting, this section consists of Component Reference Diagrams for selected Integrated Circuits (ICs). The ICs in Section 6 are identified with a large asterisk ✱ on the schematic diagrams in Section 5.

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Description 1

Introduction

This section describes the LIFEPAK 9 defibrillator/monitor as follows:

- Physical Description and Features including specifications
- Functional Description of operation and major assemblies
- Theory of Operation to the component level of major assemblies.

Physical Description

The LIFEPAK 9 defibrillator/monitor, Figure 1–1, provides a monitor-quality cardioscope, strip chart recorder including CODE SUMMARY, 3-lead ECG selection, heart rate display and alarms, multiple energy selection and synchronous cardioversion. The ECG signal is detected through patient cable electrodes, QUIK-LOOK paddles, or FAST-PATCH disposable defibrillation electrodes.

The instrument operates on either ac power or internal battery power. The battery pack, accessible from the bottom of the instrument, allows operation even if ac power fails. With the instrument plugged into ac power the battery pack continually charges even with power off.

The cardioscope uses a non-fade ECG display with a sweep rate of 25mm ± 1mm/s. The cathode ray tube (CRT) displays heart rate, systole indicator, selected lead, ECG gain, heart-rate violations, messages pertaining to the patient's condition, defibrillator information, sync markers, and status of the instrument.

The instrument delivers a controlled monophasic dc defibrillating pulse to the patient with a delivered energy content ranging from 1 to 360 joules. Both selected energy and the available energy are displayed on the cardioscope.

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The recorder can print the alphanumeric information anywhere on the paper. It operates automatically for 20s when a heart rate violation occurs. The recorder also prints the ECG trace, a copy of the stored CODE SUMMARY data, including code abstract, defibrillation, and recorder usage.

Menus display on the cardioscope allowing the operator to set default parameters at power-on. The menus include: alarm limits, lead selection, keypad test, display or recorder, and delivered energy calibration.

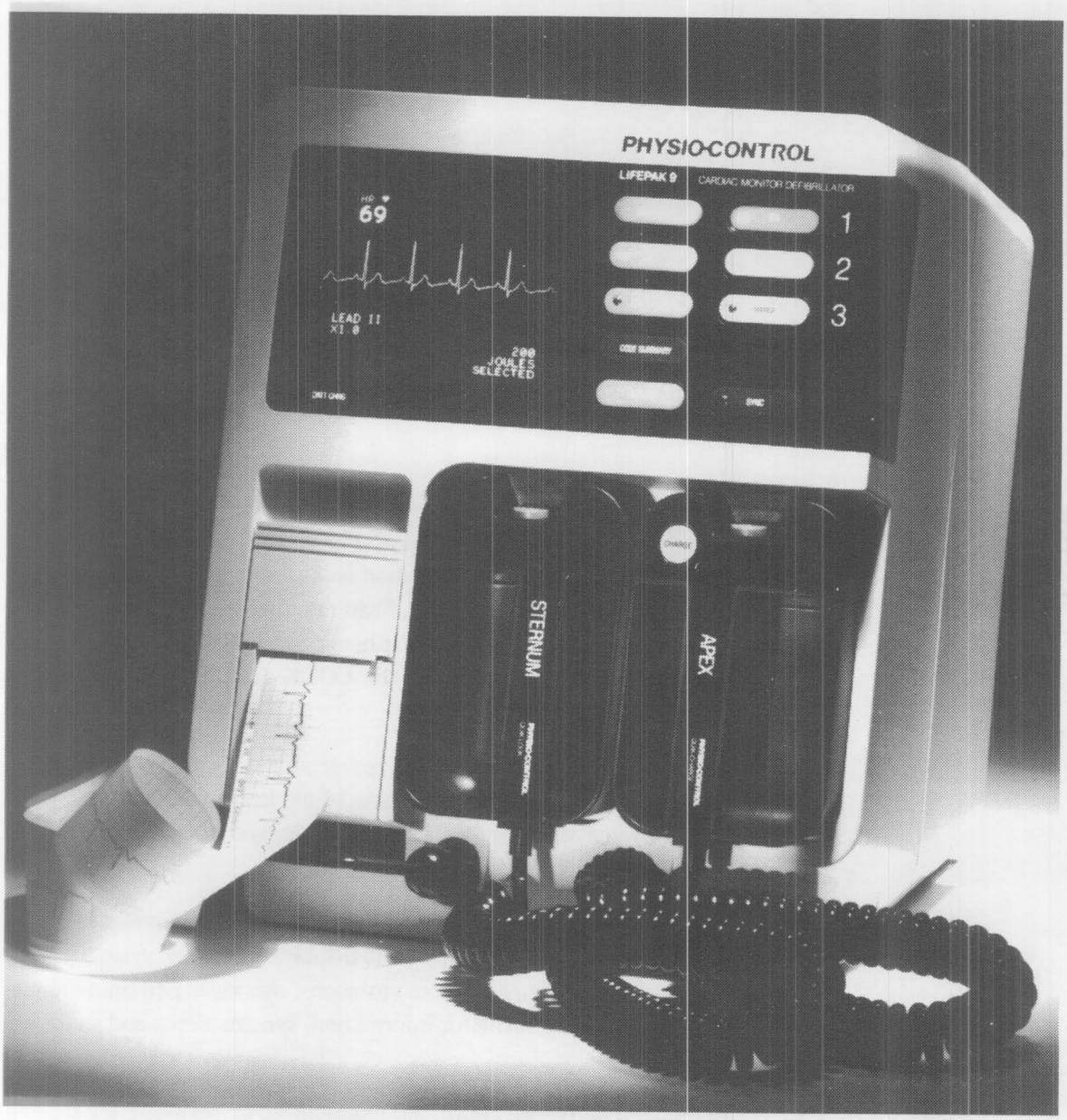

Figure 1–1 LIFEPAK 9 defibrillator/monitor

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Table 1–1 General Specifications

		Specifications*
General	AC Input Options	Nominally 120Vac (90Vac minimum, 129Vac maximum) or 240Vac (198Vac minimum, 264Vac maximum), 50 or 60Hz
	Battery	
	Type	Sealed lead-acid
	Capacity	A minimum of twenty 360J discharges before low battery indicator comes on, or 90min of cardioscope monitoring.
	Charge time	24hr to 100% capacity.
	Maximum Power Consumption	30W while monitoring, 50W while monitoring with recorder on, 160W while monitoring with recorder on and charging energy storage capacitor (160W assumes a completely depleted battery)
	Size	35.3cm (13.9in) H x 29.7cm (11.7in) W x 31cm (12.2in) D
	Weight	12.7kg (28lb)
Monitor	Input	Isolated ECG through QUIK-LOOK defibrillator paddles or 3-lead patient cable
	Common Mode Rejection	100dB minimum with respect to chassis ground at 60Hz; 65dB minimum with respect to isolated ground; common mode range for patient cable input is ≥10V peak with respect to isolated ground (with notch filter engaged)
	Patient Cable Length	4m (13 ft)
	Cardioscope Display	
	Size	76mm (3in) x 102mm (4in), non-fade
	Sweep speed	25mm/s ±1mm/s
	Frequency response (–3dB)	0.5Hz to 40Hz
	Recorder	
	Paper size	50mm x 30m (100 ft)
	Paper speed	25mm/s ±1mm/s
	Recorder mode	8s delay
	Frequency response (–3dB)	0.5Hz to 40Hz (0.05Hz to 100Hz option through SETUP menu)
	Annotation	Includes date, time, lead, gain, heart rate, and defibrillation parameters
	Heart Rate Meter	3-digit display indicates rates from 20bpm to 300bpm

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Table 1–1 General Specifications

		Specifications*
	Heart Rate Alarms	User-selectable alarm limits: three high-low settings: 150-40, 120-60, 160-90; other alarm-limit options available through SETUP menu
	Calibration	Momentary pushbutton switch on rear panel simulates 1mV signal to preamplifier
	ECG Output	1V/mV at 1.0 gain
Defibrillator	Waveform	5ms monophasic pulse (Edmark) per AAMI standard
	Output Energy (Delivered)	External paddles: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 50, 100, 200, 300, and 360J; internal paddles: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, and 50J; defibrillator output electrically isolated.
	Charge Time	Charge to 360J in less than 10s at 25° C (77°F) when ac operated or dc operated from a fully charged battery
	Output Paddle Electrode area Cord length Discharge control Frequency response (–3dB)	 82cm^2 3m (10ft) Discharge controls on both paddles in series 2.2Hz to 20Hz
	Test Load	Verifies energy delivery accuracy (±15%) at 200J
	Defibrillator Synchronizer	Synchronizes defibrillator pulse to patient-generated R wave
	Sync indicator	Marker on cardioscope identifies synchronizer trigger point. Defibrillator will discharge within 20ms after marker. Marker also appears on recorder.
	Sensitivity control	ECG SIZE pushbuttons act as threshold controls
Environmental	Atmospheric Pressure	97mmHg to 500mmHg (–570ft to 11,000ft)
	Relative Humidity	0 to 95% (non-condensing) at 0°C to 34°C (0°F to 93.2°F) 0 to 80% (non-condensing) at 35°C to 45°C (95°F to 113°F)
	Temperature Operating Storage	 0°C to 45°C (0°F to 113°F) –30°C to 65°C (–23.8°F to 149°F)

*All specifications at 20°C unless otherwise stated. Specifications subject to change without notice.

Functional Description

The LIFEPAK 9 defibrillator/monitor consists of five printed circuit board (PCB) assemblies:

- Power Supply
- Power Conversion
- Interconnect
- Main
- Display.

The Functional Block Diagram shown in Figure 1–2 provides an overall view of the instrument operation.

The Power Supply PCB functions over the full range of input voltages from 90Vac to 270Vac at 50Hz or 60Hz without input line voltage selection. The Power Supply PCB converts the ac-line power to a nominal +18.8Vdc used by the instrument.

The Power Conversion PCB implements a variety of power-handling functions: power on/off switching, additional voltage generation, defibrillation charging, and stored energy transferring. A test load circuit is also present on the Power Conversion PCB.

The Interconnect PCB provides the electrical connection between the Main PCB and the Power Conversion PCB. It also contains circuitry to produce the audible tones and to drive the front panel LEDs.

The Main PCB has three major sections of circuitry: the Preamp, the System Controller, and the Display/Recorder Interface. The Preamp is used for both the 3-lead patient cable and QUIK-LOOK paddles inputs. The System Controller directs the operation of the instrument. QRS detection, rate calculation and alarms, and synchronous cardioversion are all implemented in the System Controller software. The current state of the system microprocessor and the ECG data are transmitted from the system microprocessor to the display/recorder microprocessor, allowing the display/recorder microprocessor to select and format the appropriate CRT messages and recorder annotations.

The Display Assembly contains a Monitor PCB that drives the 5-inch diagonal cathode ray tube (CRT). It uses electromagnetic beam deflection and incorporates vertical and horizontal deflection circuitry to produce a raster scan.

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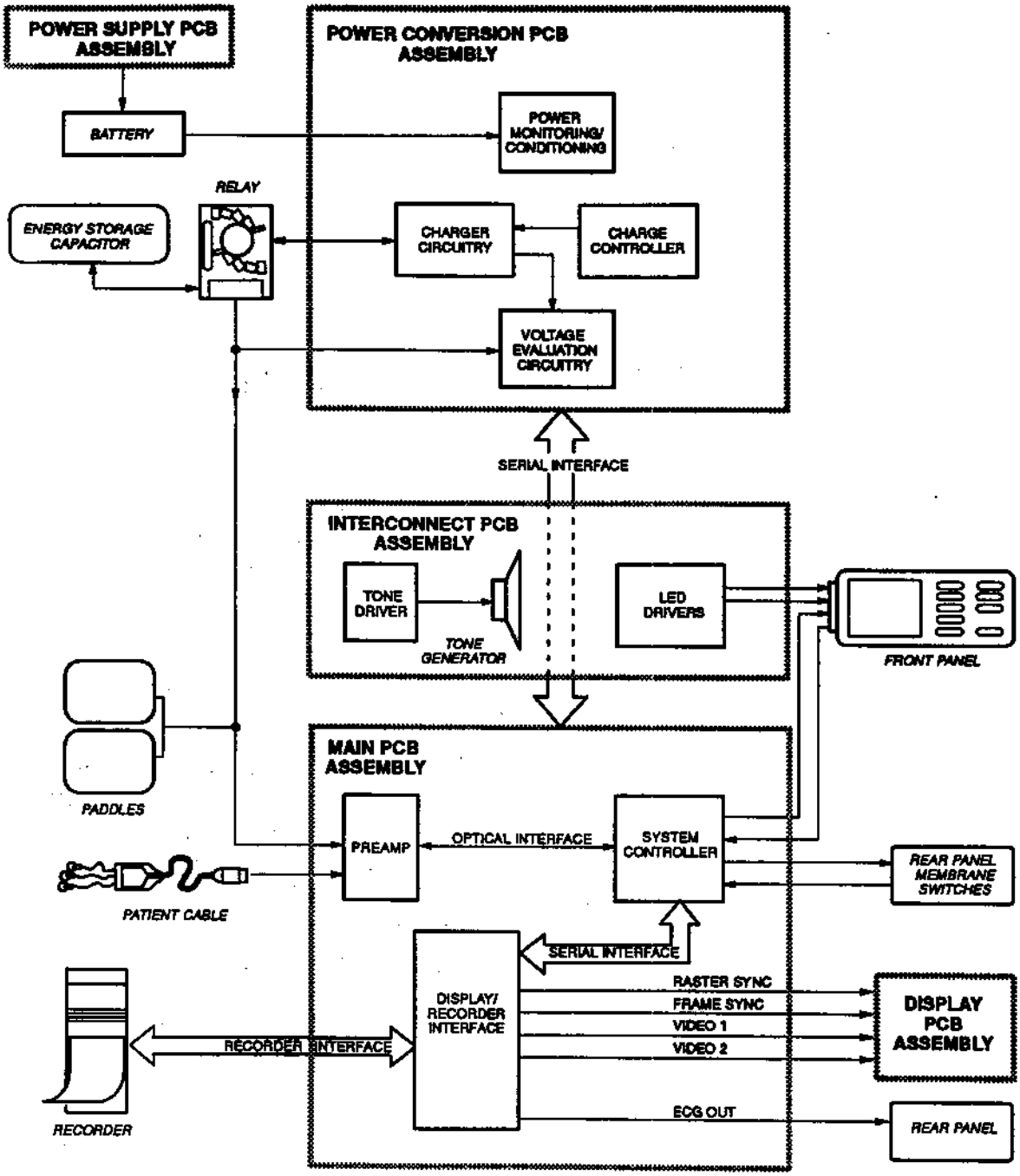

Figure 1–2 LIFEPAK 9 defibrillator/monitor Functional Block Diagram

Theory of Operation

The following paragraphs contain detailed descriptions of the LIFEPAK 9 defibrillator/monitor Power Supply PCB, Power Conversion PCB, Interconnect PCB, Main PCB, and Display PCB Assemblies. Schematic diagrams of these electrical circuits, provided in Section 5, should be referred to while reading the circuit descriptions. Information about selected integrated circuits (indicated by a ✱ on the schematic) appears in Section 6.

Power Supply PCB Assembly (803726)

The Power Supply PCB converts input ac voltage to a nominal dc voltage for the Power Conversion PCB and for charging the battery.

Power-On

When ac current flows through J1, it is conditioned by RT1, L1, C2, C3, and CR1. Resistor divider R1, R3, and R4 in series with parallel resistors R11 and R12 turn on Q1. Current builds in T1 primary windings (pins 4 and 6) and is coupled with pins 1 and 2. C6 couples the current build-up into Q1, causing saturation.

Increasing current through the T1 primary produces voltage on the base of Q2 and a voltage drop across parallel resistors R11 and R12. Q2 activation overrides Q1 and terminates the primary current. Transformer T2 sustains base drive current to Q2.

Regulation

When battery voltage exceeds the voltage threshold set by VR1, Q4 turns on and couples the voltage from T2 pins 4 and 5 to T2 pins 2 and 7. When current subsides to proper levels, Q4 turns off, providing current feedback for regulation.

Overvoltage Protection

If the regulation circuit fails, silicon controlled rectifier (SCR) CR12, together with CR13, R17, and R18 protects the load from damage. CR13 sets a voltage threshold which, when exceeded, triggers SCR CR12 to short the Power Supply circuit output. The operator monitors the Power Supply status from the +18V LINE STATUS signal and may reset the protection circuit by removing ac power to the instrument.

Output Isolation

CR11 isolates the Power Supply output from the filter network to protect it from the battery voltage when ac power is removed. This is necessary because the battery is connected in parallel with the Power Supply.

Battery

The +16Vdc, lead-acid battery pack is wired directly to the Power Supply output. The battery receives a constant charging current whenever the instrument is connected to ac power. (International configurations also require that the MAINS POWER switch is on.) As the battery approaches

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full charge, the supply operates in constant voltage mode. Current limiting sets the maximum charge current available to the battery at about +4.5A. This limit is implemented when the Power Supply continues to source current into a dead short, a requirement for charging a severely depleted battery.

BATT CHRG Indicator

The battery charging LED signal illuminates the BATT CHRG indicator whenever the ac power is connected to the instrument. An interlock in the battery harness prevents the indicator from lighting if the battery is not installed.

Power Conversion PCB Assembly (803724)

The Power Conversion PCB contains circuitry for: power on/off switching, additional voltage generation and monitoring, energy storage capacitor charging, and defibrillation-energy transferring. Refer to Figure 1–3, page 1–9.

Power Control

The Power Control circuit regulates battery voltage to the circuits which control instrument operation. The circuits directly affected by the Power Control circuit are: Switching Power Supply, Logic Power Monitor, External Control Input, Low Energy Charge Rate, and Energy Storage Capacitor Charger circuits.

The Front Panel ON momentary pushbutton provides a start-up signal for the Power Control circuit. When ON is pressed, voltage is applied to the gate of Q11. Q11 turns on Q10, and provides the SWBATT voltage for the rest of the Power Conversion PCB Assembly circuits.

The power switch toggles the Power Control circuit on and off. When the power switch is first pressed, V BATT passes to the gate of Q11, causing Q11 to conduct, which causes Q10 to conduct. A portion of V BATT is held on the gate of Q11 by R52, which keeps Q10 conducting. During this phase the PWR SW MONITOR line is low. When ON is pressed a second time, V BATT is divided by R108 and R109, forward biasing CR44 and switching the PWR SW MONITOR line high. The system microprocessor reads the low-to-high transition and activates the Logic Power Monitor circuit, disabling the Power Control circuit.

Logic Power Monitor

The Logic Power Monitor checks the logic supply voltage. If the logic voltage is above or below normal limits, it deactivates Q11 and disables the Power Control circuit. Comparator U5 functions as a window detector for high voltages (U5A) and low voltages (U5B). The comparator reference voltages are set by diode IC U4 at +2.5V. The output of the Power Control circuit, SWBATT, generates the operating voltage for U5, U4, and the Switching Power Supply.

The system microprocessor shuts down the instrument by sending a low signal to the POWER ENABLE line. This switches the open collector output of U5B to ground, which turns off Q11, disabling the Power Control circuit. Electrical isolation is provided by CR24 and R39.

A time delay function in the Logic Power Monitor circuit prevents the Power Control circuit from shutting down while operating voltages are still rising during initial power-on. Capacitor C26 accomplishes this for the high-limit detector (U5A) and C18 for the low-limit detector (U5B).

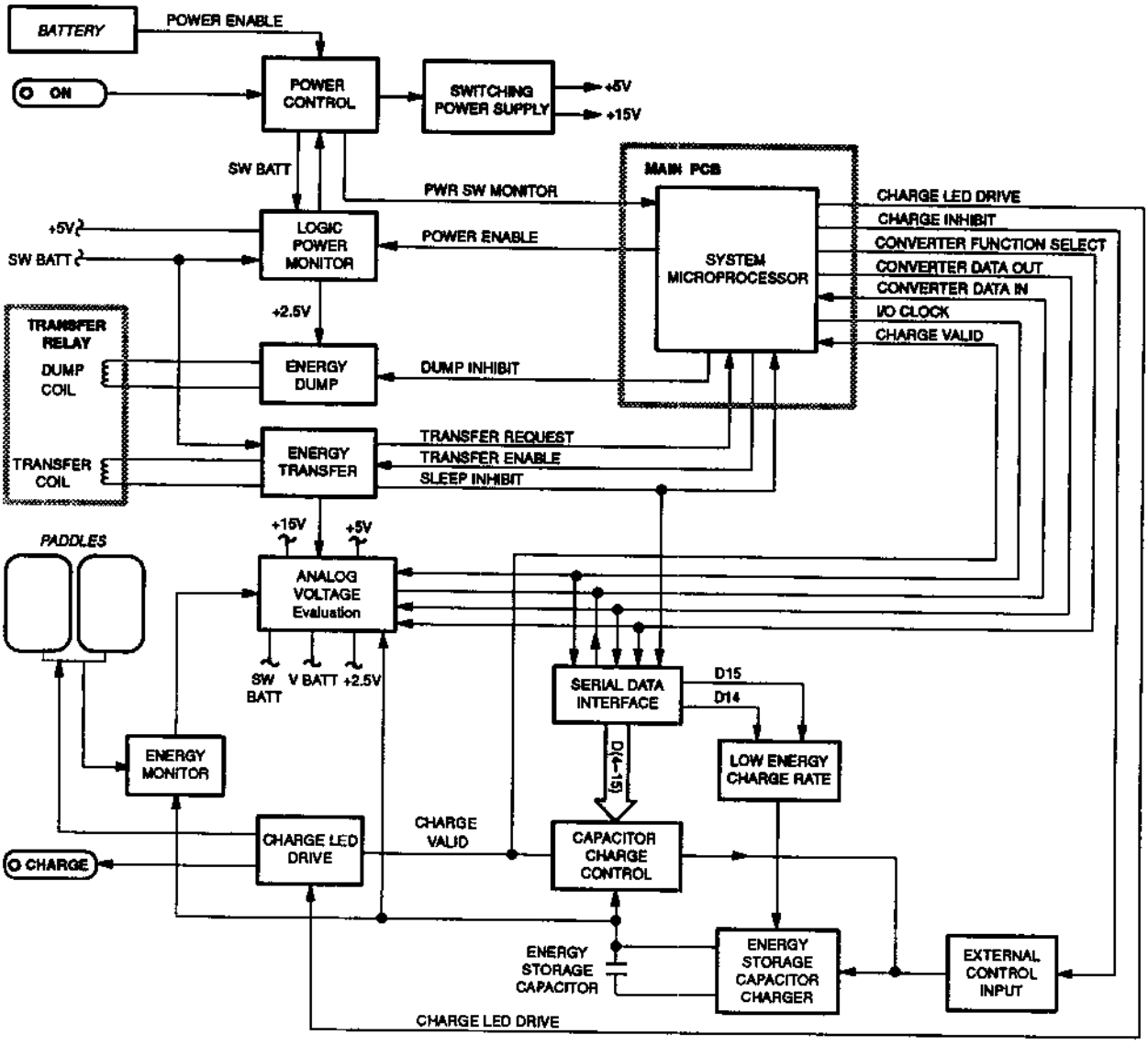

Figure 1–3 Power Conversion PCB Block Diagram

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The low- and high-limit detector inputs to the test connector are used to check circuit performance by serving as test points to measure voltage. Voltage measurements check the accuracy of voltage dividers R41, R42, R43, and R56 (relative to the +5V supply).

Switching Power Supply

The Switching Power Supply using a pulse-width regulator (U3) and a flyback-coupled inductor (T2) produces the +5V to +15V supply voltages used by the rest of the equipment.

The pulse-width regulator (U3) contains an oscillator, reference voltages, an error amplifier, and drive circuitry for Q12. Oscillation frequency is set at 90Hz by R30 and C12. The +15V output feedback at U3 pin 2 determines the outgoing pulse-width. The pulse output at U3 pin 6 provides a constant frequency pulse by driving an N-channel FET (Q12) and dumping the V BATT voltage into the primary of T2. Two diodes, CR28 and CR29, protect Q12 from high voltages caused by leakage inductance from the primary.

External Control Input

The Energy Storage Capacitor Charger circuit is externally controlled by the N-channel MOSFET, Q9. Two resistors (R58 and R59) provide forward biasing for Q9 whenever power is applied to the instrument. A charge cycle for the energy storage capacitor initiates when the system microprocessor on the Main PCB sets the CHARGE INHIBIT line at low voltage, turning Q9 off. The inverting input of U2A rises to the required +5V minimum.

Energy Storage Capacitor Charger

The Energy Storage Capacitor Charger circuit uses a flyback transformer to charge the energy storage capacitor through the Transfer Relay. The core of the circuit consists of the following components: T1, U2A and U2B, Q1, Q2, Q5–Q7, and C17.

Amplitude comparators U2A and U2B determine the drive pulse for the primary of T1. The input to the energy storage capacitor at U2A pin 2 is controlled by the External Control, Low Energy Charge Rate, and Capacitor Charge Control circuits. If any of these incoming signals fall below the +2.5V reference at U2A pin 3, the output switches high, inhibiting the drive to the primary of T1.

Once a charge cycle initiates at U2A pin 2, the active low output turns on transformer driver Q5 which shuts off Q7. Timing for the transformer drive pulse-width is provided by Q7, U2B, C17, and R23. While Q7 conducts, the voltage across C17 is zero. When Q7 shuts off, the voltage at SWBATT starts charging C17. When the voltage at C17 exceeds +2.5V, the output of U2B switches low, forcing U2A output high, preventing current flow to the primary of T1.

The power circuit to the primary of T1 consists of two stages: Q5 and Q6 function as push-pull drivers, Q1 and Q2 provide improved current handling for the drive pulse.

The secondary winding of T1 supplies the energy stored on the energy storage capacitor for patient defibrillation. The output is therefore subject to potentials of up to +4.5kV under normal operating conditions. C1 limits the single pulse voltage rise to about +1.5kV, providing circuit-response time for control of the output voltage.

Low Energy Charge Rate

This circuit is centered around op amp U17A and is active only during low battery voltage levels, or when an energy level below 30J is selected. When a low battery voltage is detected, the Low Energy Charge Rate circuit slows the charge rate for the energy storage capacitor, reducing the amount of power required for charging. Similarly, the charge rate is slowed when a low charge energy setting is selected, ensuring the energy storage capacitor will not charge too quickly for the Capacitor Charge Control circuit to detect the energy level.

A signal from the system microprocessor at the energy request register, U20, determines the output of U17B. When an energy level of less than 30J is selected, low signals are applied to the inputs of U15D from U20. U15D output then switches low, forcing CR45 to reverse-bias. This pulls the noninverting input of U17A to +5V, changing the output of U17A.

The signal from U17A controls the charge timing circuit (U2B, C17, and R23), and in turn, the output of U2A. During normal charging, the effect of this signal is blocked by CR46. When U17A pin 1 is driven high, additional current is supplied to C17. This reduces the on-time of U2A, reducing current to the primary circuit and slowing the rate of charge of the energy storage capacitor. This reduces the power consumption of the Energy Storage Capacitor Charger to less than half of normal. At 360J, the charge time is increased to 30s.

The instrument can be operated with low battery voltage if the power required for charging the energy storage capacitor is reduced. Op amp U17A detects low battery levels by monitoring the SWBATT voltage at the inverting input and comparing it with the +2.5V at the noninverting input. When the threshold limit set on the noninverting input of U17A exceeds the SWBATT voltage on the inverting input, it indicates a failing battery. The output of U17A then functions as in the previous paragraph.

Capacitor Charge Control

The Capacitor Charge Control circuit controls the Energy Storage Capacitor Charger. It achieves and maintains a selected voltage on the energy storage capacitor and reports the capacitor voltage status to the Main PCB system

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microprocessor. The circuit core consists of op amp U17B and comparators U8A, U8B, and U8C.

Op amp U17B sets and maintains the selected voltage to the energy storage capacitor by controlling an inhibit signal to pin 2 of U2A. When a selected voltage is achieved, U17B shuts down U2A, disabling the Energy Storage Capacitor Charger.

To set the gain for a particular charge voltage, digital-to-analog (D/A) converter U18 is connected between the inverting input and the output of U17B. The output of the D/A converter is controlled by selection of a 12-bit word by the system microprocessor on the Main PCB. Resistors R2 and R4 function as voltage dividers for the energy storage capacitor output voltage. When this divided voltage is applied to the noninverting input of U17B, the gain of U17B rises correspondingly.

Comparator U8C provides switching for the Energy Storage Capacitor Charger in response to input from U17B. When the output of U17B rises above +2.5V, U8C switches low. This low inhibit signal switches the output of U2A high, shutting down the Energy Storage Capacitor Charger.

Comparators evaluate the charge stored on the energy storage capacitor with respect to the defibrillation energy selected. U8B detects values greater than the minimum required for in-tolerance energy; U8A detects values less than the maximum allowed for the same energy setting. The outputs from U8A and U8B form the CHARGE VALID signal, indicating valid energy charge levels. This signal informs the Main PCB system microprocessor about the status of the selected charge energy.

Energy Transfer

The Energy Transfer circuit transfers the energy stored in the energy storage capacitor to the patient. The circuit is centered around U6, Q4, C9, and CR4.

When the sternum and apex discharge pushbuttons on the paddles are pressed, the STERNUM TRANSFER and APEX TRANSFER lines at J17 produce the TRANSFER REQUEST signal from the output of U15A which is sent to the Main PCB system microprocessor. If all energy transfer parameters are correct, the system microprocessor returns a TRANSFER ENABLE signal through U11A and U14C.

The TRANSFER ENABLE signal initiates two functions; it enables and maintains a constant current to the transfer relay drive. The SWBATT voltage is stored in C9, enabling energy transfer to occur with minimum battery voltage dissipation. Transistor Q4 and SCR CR4 control this voltage and direct it to the transfer relay. To enable the relay drive, the signal from U14C turns on CR4. The signal from U11A forces U6A low, causing Q4 to conduct. With both CR4 and Q4 conducting, current starts to flow through

R62. To maintain a constant current to the transfer relay when current through R62 increases, the noninverting input of U6A goes higher than the reference voltage at the inverting input and the output switches high. This turns off Q4, causing the current to decrease through R62, switching U6A output low.

The high noise levels involved in the transfer of stored defibrillation energy can jeopardize the function of many types of logic signals, particularly if any are in transition from one state to another. To overcome this effect, the system and display/recorder microprocessors and other high speed logic are rendered inactive during transfer. To accomplish this, U6B discharges C35 at the input of comparator U8D and holds U8D low during the time that the Transfer Relay coil is energized. The output of the U8D remains low for an additional period to allow the Transfer Relay to reopen and any stray current to dissipate. This signal, SLEEP INHIBIT, is used as a logic activity enable.

SLEEP INHIBIT also clears shift registers, U19 and U20. This sets all inputs to U17B at 0V, which inhibits the drive to the Energy Storage Capacitor Charger. Inadvertent deactivation of the charge inhibit will then cause no hazard due to stored voltage on the energy storage capacitor.

Energy Dump

The Energy Dump circuit provides a current path for unused energy stored in the energy storage capacitor. If the paddles are charged but not discharged within one minute, the Energy Dump circuit is activated.

The internal dissipation of stored energy is accomplished with the dump relay and a power resistor located within the Transfer Relay Assembly. The dump relay is held in the normally closed condition by a permanent magnet. When a charge is initiated, the contact opens to prevent the stored energy from draining.

The system microprocessor controls Q3, preventing the paddles from being charged for longer than one minute. Prior to any charge activity, the system microprocessor on the Main PCB holds the DUMP INHIBIT line low, keeping Q3 turned off and the dump relay closed. During charging, the DUMP INHIBIT line is switched high, turning on Q3 and opening the dump relay. If the one minute charge time-out expires or a different energy setting is chosen, the system microprocessor turns Q3 off, closes the dump relay, and dissipates the stored energy.

Energy Monitor

The Energy Monitor circuit checks the energy level that goes to the internal test load. When energy is transferred as a test, this circuit senses the energy across the test load and informs the Main PCB system microprocessor what energy level was transferred. The system microprocessor then displays that information (e.g., 200J DELIVERED).

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The value representing the defibrillation pulse is acquired by monitoring the path of the delivered energy with a current transformer, T3. A current of the same proportions is generated in the secondary with each transfer pulse. Half-wave rectifier CR8 delivers the secondary current to C10. This voltage is indexed in the system microprocessor to a specific delivered energy.

C10 must start each transfer cycle with 0V for accurate evaluation of the delivery. FET Q8 is in parallel with C10, resetting the capacitor before each charge energy pulse. The gate of Q8 is driven by the inverted CHARGE INHIBIT signal. Q8 shorts C10 when the charge is enabled, so the Energy Monitor circuit can determine the correct energy level each time the instrument is ready to deliver energy. Op amp U1A functions as a noninverting buffer, providing high-impedance isolation from the rest of the signal processing circuitry.

Serial Data Interface

The Serial Data Interface consists of four lines; CONVERTER DATA IN and CONVERTER DATA OUT provide full communication while CONVERTER FUNCTION SELECT and I/O CLOCK are used for data flow control. The Analog Voltage Evaluation circuit and the D/A converter U18, used with the Capacitor Charge Control circuit, share this common set of serial lines for communication with the system microprocessor.

A low on the CONVERTER FUNCTION SELECT line at P14 pin 7A enables the Analog Voltage Evaluation circuit for data transfer. The data flow rate is set by I/O CLOCK at P14 pin 6A. A high on the CONVERTER FUNCTION SELECT line at P14 enables 8-bit shift registers U19 and U20, allowing I/O CLOCK access to the register clock inputs. Information on the CONVERTER DATA OUT line is stored in the low-order location and all other bits are advanced one position during the positive-going transitions of I/O CLOCK. At the same time, U12A through U12C route the output data on the CONVERTER DATA IN line. A logic high at U11C pin 8 following a byte transfer indicates a communication failure.

Analog Voltage Evaluation

The Analog Voltage Evaluation circuit monitors a number of functional and operating voltages in the Power Conversion PCB. An analog-to-digital (A/D) converter, U9, is used to convert these voltages to digital code for evaluation by the Main PCB system microprocessor. The system microprocessor accesses the appropriate voltage inputs to U9 and evaluates them for correct tolerances.

Charge LED Drive

The CHARGE LED DRIVE signal from the Main PCB system microprocessor controls Q14 when the energy storage capacitor is charging. Q14 drives the front panel CHARGE LED and the paddle LED. R128 on the

drain of Q14 limits the current to the paddle LED. The gate of Q13 is connected to the CHARGE VALID signal. When the voltage for the selected energy level has been reached, Q13 conducts. Q14 then clamps the charge LEDs on continuously.

Interconnect PCB Assembly (803761)

The Interconnect PCB provides electrical connection between the Main PCB and the Power Conversion PCB, drives the front panel LEDs, generates the audible tones, and provides the ECG Out signal.

LED Drive

The LED drive circuitry consists of Q4, Q5, Q13, R14, R15, and R11. Static protection is provided by R9, R21, R22, C6 through C8, and CR1 through CR11.

Audio Generation

The Main PCB system microprocessor chooses 1 of 8 volume levels by writing the appropriate binary number; 000 for the loudest and 111 for the softest. These 3 lines VOL CONTROL BIT (1 through 3) are routed to 3-to-8 decoder U1 on the Interconnect PCB. Static protection is provided by R1 through R4, C1 through C3, and C5.

The decoder sets the voltage required for the volume level selected by the system microprocessor. When the decoder output turns on one of the transistors, the corresponding resistor is in series with R8. The center tap of the resistor divider is routed to the input of either U2A or U2B as determined by Q11, Q12, and Q6. The output of U2A or U2B applies the voltage to the piezoelectric transducer, X1.

The free-running oscillator in the system microprocessor generates the desired tone frequency. This oscillator generates a square wave, AUDIO DRIVE, which is routed to the gate of Q11. If the voltage at the gate of Q11 is low, Q12 conducts, grounding U2A pin 3. Q6 then shuts off, applying the selected voltage to U2B pin 5. If the voltage at the gate of Q11 is high, Q11 switches on and Q12 switches off, applying the selected voltage to U2A pin 3. Q6 turns on, grounding U2B pin 5. In this way, the frequency of the oscillator controls transistors Q11, Q12, and Q6, providing drive to the transducer. Op amps U2A and U2B provide buffering and high current drive to X1.

ECG Out

The ECG signal produced by this circuit is for display on an external monitor and is separate from the ECG signal seen on the display or recorder of this instrument. The PREAMP CONTROL signal from the Main PCB system microprocessor connects to JK flip-flop U4 pin 1. The falling edge of this signal starts an A/D conversion in the Main PCB preamp and sets the Q output of the flip-flop. PREAMP INPUT (from Main PCB U23) connects to U4 pin 3. The falling edge of this signal indicates the end of A/D conversion

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and resets the Q output of the flip-flop. The resulting output at U4 pin 15 is a 540Hz pulse-width-modulated (PWM) square wave that is passed through a Butterworth filter consisting of R24 through R26, C9 through C11 and U3A. The output of the filter is the average amplitude of the PWM square wave. The signal is centered at 7.5V by C12, R27, and R28, then amplified by U3B, and R29 through R31 providing the 1V/mV output.

Main PCB Assembly (803715)

The Main PCB Assembly consists of three major circuits: the Preamp, the System Controller, and the Display/Recorder Interface. The Preamp circuitry converts the ECG from the patient cable to sampled ECG. The converted ECG signal is optically connected to the system microprocessor which does the initial ECG signal processing. The system microprocessor is central to the System Controller circuitry. The System Controller provides the interface between the operator inputs and the functions of the instrument. The Display/Recorder Interface formats the CRT and recorder displays using the information from the system microprocessor.

Three major circuits control many functions. Table 1–2 groups these functions under the appropriate major circuit name. Paragraph descriptions for each function follow in the order listed. Refer to Figure 1–4, page 1–17.

Table 1–2 Main PCB Functional Circuits

Preamp	System Controller	Display/Recorder Interface
Isolated Power Supply	System Controller	Display/Recorder Controller
Front-End Protection	Front and Rear Panel Controls Interface	System Clock
Lead Select	Audio Alarms	Address Decode
Optical Interface	Charge Control	Display Gate Array
Instruction Decoding	I/O Protection	Video RAM
Instrumentation Amplifier		Font EPROM
Filtering		Program EPROM
DC Restore		Program RAM
Echo		Recorder Power
		Motor Speed Control
		Printhead Control
		Printhead Resistance Evaluation

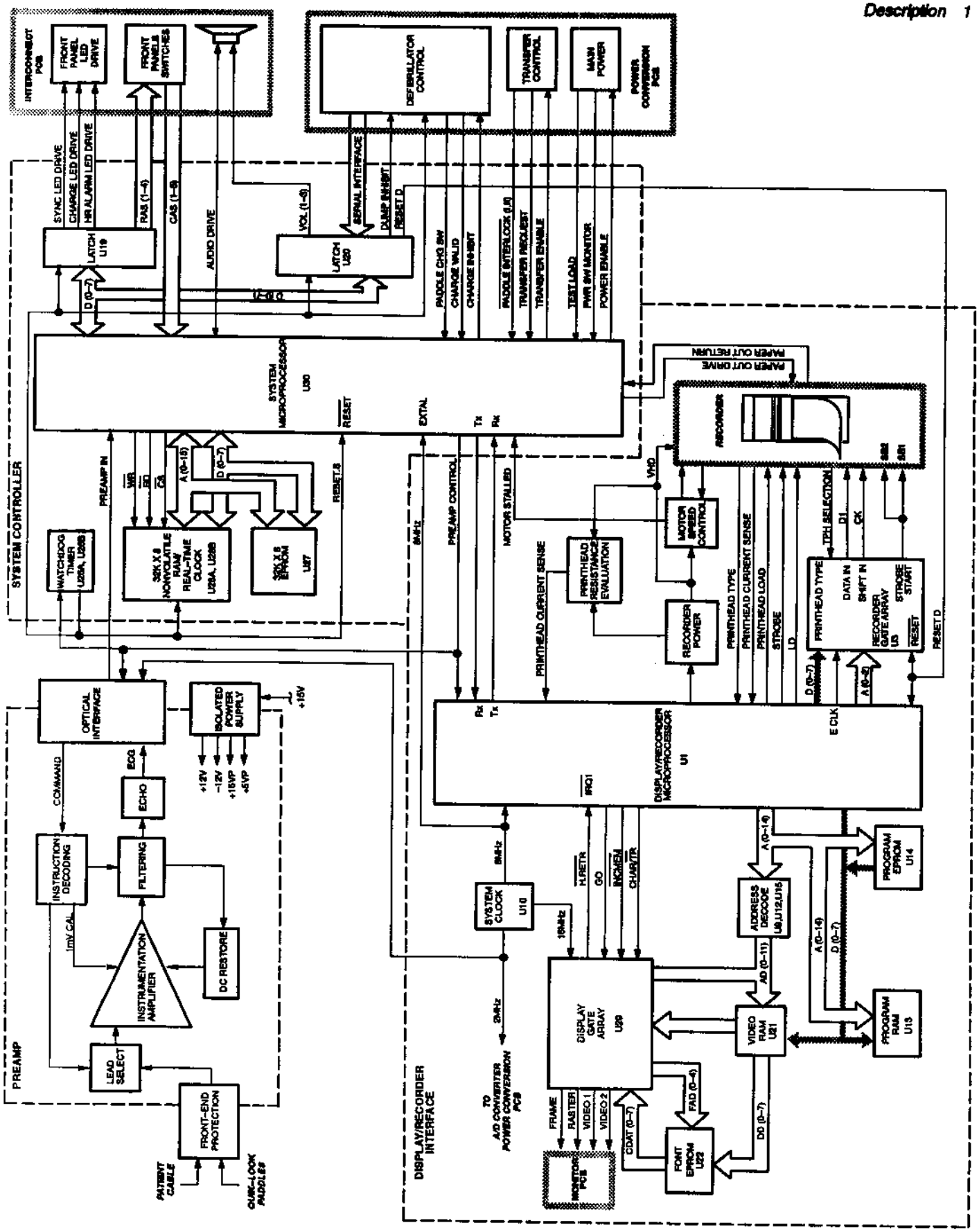

Figure 1–4 Main PCB Block Diagram

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Preamp

Isolated Power Supply. The Preamp circuitry requires +15Vdc, +12Vdc, –15Vdc, +5Vdc, and –12Vdc supplies. The drive for transformer T1 is generated by pulse-width modulator U5. C12 and R28 set the frequency between 12kHz and 24kHz. The secondary of T1 is applied to full-wave bridge CR20. The positive half of the ac input waveforms are stored at C87, forming the isolated +15V supply. The negative ac waveforms are stored at C86, forming the isolated –15V supply. Regulators U38 and U39 provide isolation for the more sensitive circuitry from the heavier loads. Since the +5Vdc loads are synchronous and small, U37 doubles as a regulated supply and a reference source.

Front-End Protection. VSP1 through VSP3 limit the input current to 2mA protecting against voltage surges. Isolation for the paddles input is provided by R131 and R132, which guard against excessive charge being introduced to the Preamp. Diodes CR18, CR19, and CR28 clamp the differential paddle voltage when K1 is switched to the leads mode.

Lead Select. To select between paddles and the different patient leads, latch U33 is loaded with the decoded data from counter U32. U33 controls relay K1, U43A, and analog switches U42 and U41. To select between patient leads or paddles, U33 causes Q8 or Q9 to conduct, switching the state of K1 to the desired position. Patient leads are selected when Q8 conducts; paddles are selected when Q9 conducts. If patient leads are selected, analog switch U42 selects the lead (I,II,III, or STD) requested by the output of U33.

Optical Interface. Command pulses from the system microprocessor pass through the optical interface and perform three different functions: synchronize the ECG conversion, select 1 of 5 patient cable leads, and induce a +1mV calibration signal. The system microprocessor uses an internal timer to transmit a pulse of variable duration (about 80ms to about 1.2ms) and a fixed-frequency period (540Hz). The variable-duration pulse from the system microprocessor enables U4 to start counting, creating a 16kHz pulse train at U4 pin 4.

The system microprocessor controls the count of the pulse train by interrupting the output with a CLR signal (see TP6, Figure 1–5). The 16kHz pulse drives the infrared-emitting diode in U7 providing pulse isolation. Comparator U34D provides waveform conditioning for the pulse train as it passes to the Instruction Decoding circuit, U32 and U33.

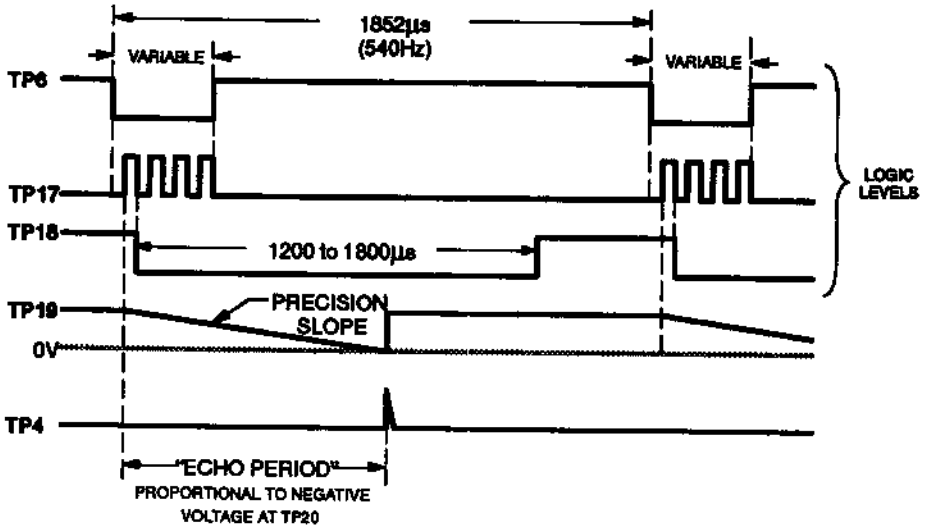

Figure 1–5 Preamp Timing

Instruction Decoding. The pulse train commands from the system microprocessor are coded by the number of pulses (see Table 1–3). The number of pulses represents a binary number, each number corresponds to a particular command function. Each set of pulses performs two tasks; application of a specific preamp setup, and initiation of ECG signal conversion to a digital equivalent. The rising edge of the first pulse is detected by U31A, which responds by sending a pulse to U34A. This initiates the ECG conversion. Monostable multivibrator U31B detects the falling edge of the first pulse and clears U31A so that ECG conversion is not initiated with every pulse on the pulse train.

Flip-flop U36A and counter U32 form a five-stage counter that responds to the pulses from the pulse train (see TP17, Figure 1–5). The first rising edge of the pulse train causes the five-stage counter to load from the preset inputs (pins 6, 5, 3, and 4). Subsequent edges count up from the preset inputs. Because of the timing of RC network R101 and C74, U31B times out at about 1.5ms and sends a positive edge to U33, latching the decoded command signals. These command signals select between the leads and paddles.

Instrumentation Amplifier. The typical ECG signal at U41 and U42 is no more than 16mV p–p and requires amplification for further signal processing. Together U44A and U44B form a differential input amplifier with the gain set by RN2 pins 1 and 2, R144, and RN2 pins 3 and 4. Op amp U44D amplifies the differential signal and rejects a common-mode signal from U44A and U44B. This common-mode signal (mainly 60Hz) is generated from the outputs of U44A and U44B through voltage dividers R148 and R149. Next, the common-mode signal is inverted and amplified by U35D.

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This signal then passes through analog switch U41 and relay K1, which routes it to the unused patient lead (LL) cancelling common-mode signals at the patient source.

Table 1–3 Preamp Pulse Widths

Pulses at Tp17	Pulse Duration At Tp6	Result on Preamp Setup
1	64msec	Not used
2	128msec	Not used
3	192msec	Not used
4	256msec	Lead III
5	320msec	Lead II
6	384msec	Lead I
7	448msec	Std
8	512msec	Lead III + Cal
9	576msec	Lead II + Cal
10	640msec	Lead I + Cal
11	704msec	Std + Cal
12	768msec	Lead III + Leads Coil Drive and Switch Smooth
13	832msec	Lead II + Leads Coil Drive and Switch Smooth
14	896msec	Lead I + Leads Coil Drive and Switch Smooth
15	960msec	Std + Leads Coil Drive and Switch Smooth
16	1024msec	Lead III + Cal + Leads Coil Drive and Switch Smooth
17	1088msec	Lead II + Cal + Leads Coil Drive and Switch Smooth
18	1152msec	Lead I + Cal + Leads Coil Drive and Switch Smooth
19	1216msec	Std + Cal + Leads Coil Drive and Switch Smooth
20	1280msec	Lead III + Paddles Coil Drive and Switch Smooth
21	1344msec	Not used
22	1408msec	Not used

The +1mV calibration signal is created by an instruction from the system microprocessor which sets U33 pin 7 high. When U43A closes, a –5V offset signal is applied to U44A pin 2 and U44B pin 6. This adds about a +1mV differential offset to the input without changing the gain of the input stages.

Filtering. Filtering provides a uniform signal bandwidth during normal operation. The preamp filtering is comprised of two stages centered around op amps U44C, U45D, U45A, and U45B. In the first stage, U44C and U45D function as a high-pass filter for Preamp, DC Restore, and switch smoothing,

blocking frequencies below 0.024Hz. In the second stage, low-pass filter U45A removes frequencies above 200Hz. U45B functions as a 540Hz notch filter.

DC Restore. The DC Restore circuit compensates for any unwanted dc offset originating from switch smoothing, defibrillation, or motion artifact. This preserves the dc offset level required by the Echo circuit. DC Restore controls any transient signals, otherwise the high potential gain of the Instrumentation Amplifier would greatly amplify the dc level input for conversion. Under normal operation, the A/D conversion dc level at TP19 is +1V to +11V.

Switch smoothing is the process of limiting the response of the preamp to dc offset voltages when switching from one lead (I, II, III, or STD) to another. This function is initiated when the appropriate number of pulses at TP17 (see Table 1–3, pulses 12 thru 20) turns on Q8 or Q9 and switches U42 to the selected lead. When Q8 switches on, C90 discharges from +12V, causing Q11 to conduct. Q11 changes the high-pass filter by switching R161 in parallel with R165. This filter, because of R161, limits the signal passband to above 40Hz.

Transient signals associated with defibrillation are sensed by op amp U45C. U45C functions as a window comparator and responds with a positive output when the voltage at its input exceeds ±2V. R172 and R147 apply a negative bias to the noninverting input of U45C; R171 and R143 apply a positive bias to the inverting input. C104 and R151 are a low-pass filter that prevents very short spikes (such an an internal pacing spike) from inducing DC Restore. The output of U45C drives transistor Q10, routing the signal through high-pass filter U44C and U45D. Resistor R160, with U44C and U45D, limits the signal passband to 5Hz.

When PADDLES is selected, further passband limiting is required to eliminate motion artifact introduced by the paddles when used in the QUIK-LOOK mode. A command pulse selects paddles mode, (see Table 1–3, pulse 20), turning Q9 on. When Q9 conducts, flip-flop U36B is loaded so that the next clock pulse at pin 6 switches the Q output high. Analog switch U43B then closes, bringing R155 in parallel with R165 in the high-pass filter, and limiting the ECG signal passband to above 2Hz.

Echo. The ECG signal is converted to a pulse-delay period on command from the system microprocessor. This period is from the time the system microprocessor receives the convert command until the "echo" pulse is sent back to the system microprocessor. It is proportional to a sample of the ECG signal (see Figure 1–6). When the echo pulse is sent back to the system microprocessor (across an opto-isolator), the system microprocessor converts the pulse-delay period to a number.

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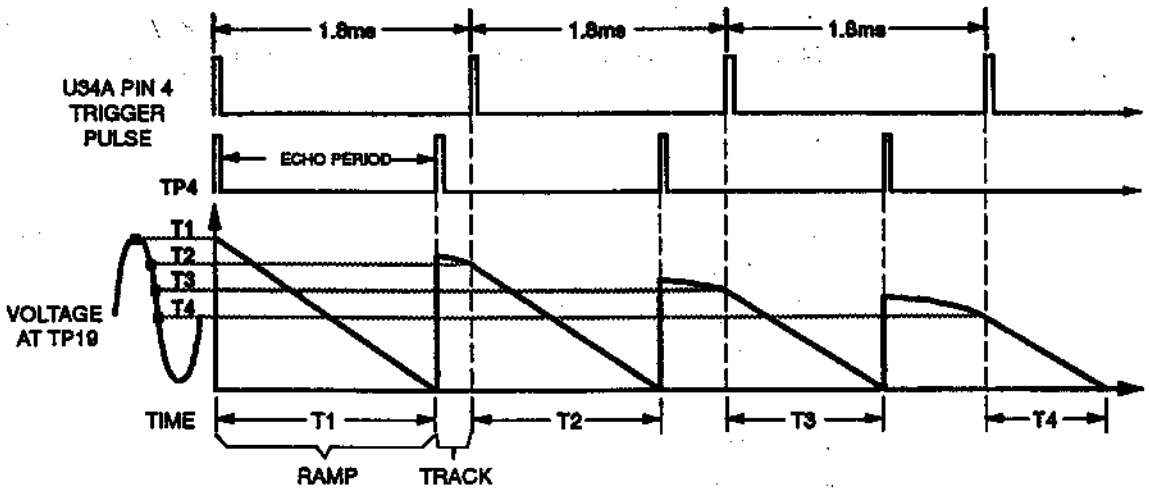

Figure 1–6 Echo Period

ECG conversion begins when the pulse train at the output of counter U4 passes to U32 pin 2. The rising edge of the first pulse clocks U31A, which sends a trigger pulse every 1.8ms to U34A. The ECG signal is offset to –6.3V at the output of U35A, providing a signal range of –1V to –11V for conversion.

The ECG signal from U35A passes to a track and ramp circuit consisting of U35B, U35C, Q7, and C76. This circuit controls the duration of the echo period. The track phase begins when Q7 conducts, which causes the ECG signal at U35B to charge sampling capacitor C76. The ramp phase starts when comparator U34A receives the trigger pulse (every 1.8ms), driving the output to –12V. This voltage passes to the gate of Q7 turning Q7 off. The +5V line and R122 provide a constant current source to the inverting input of U35C. When Q7 turns off, the constant current source causes a linear discharge from C76. This discharge produces a ramp output from U35C (see Figure 1–6).

While the track and ramp circuit is tracking, comparator U34A receives the trigger pulse from U31A. This drives the output of U34A to –12V, turns off Q6, and allows the +15V supply to charge C72 through voltage dividers R100 and R99. The output of comparator U34C controls the on-time of Q6, which discharges C72 through opto-isolator U6 and creates the echo signal.

The duration of the track and ramp circuit's ramp output determines how long the output of U34C is low and sets the duration of the echo period. When the ramp output of U35C reaches 0V, the output of comparator U34B switches to –12V, presenting this voltage at the inverting input of U34C.

This causes the output of U34C to switch to high impedance, turning on Q6, and allowing the echo signal to be coupled through opto-isolator U6.

System Controller

The System Controller circuit receives input signals from the front panel and sends commands to the CRT, recorder, and defibrillation circuits. The central component of this circuit is system microprocessor U30, together with external RAM and ROM devices. The system microprocessor primarily converts the ECG echo pulse widths to sample values for the CRT and recorder. These ECG samples are then sent to the display/recorder microprocessor for filtering and display of the CRT.

U30 communicates with the display/recorder microprocessor through two asynchronous serial transmit and receive lines at pins 12 and 13. In addition to the three 8-bit I/O ports contained in U30, 16 extra output lines are created by routing D0 through D7 in parallel out to octal latches U19 and U20.

The operating software for the System Controller is contained in U27, a 32k x 8 EPROM. Battery-backed RAM U28A, provides data storage, including the calibration constants. DIP socket U28B, contains the lithium energy cell and real-time clock information. Address decoding is performed by 3-to-8 decoder U25, using only the outputs at pins 12, 13, and 14.

Multivibrator U26 and flip-flop U16 form the watchdog circuit for the system microprocessor (U30) and the display/recorder microprocessor (U1). The watchdog circuit monitors the 1.8ms preamp trigger pulse and resets both microprocessors if the pulse width is out of tolerance. An RC network consisting of R46 and C31 is used by U26 to detect a pulse width that is too short; R47 and C33 detect a pulse width that is too long.

Controller U46 monitors the +5V supply and a system reset as needed. This protects the RAM memory and prevents spurious microprocessor activity. If the controller detects that the +5V supply is out of tolerance, the output at NOT CEO switches high and causes Q5 to conduct. Q5 conducts, pulling the voltage at R45 low. This low logic level (through U23C, U18A, and U17A) goes to the NOT RESET lines for the system microprocessor and the display/recorder microprocessor.

Front and Rear Panel Controls Interface. Signals from the front and rear panels are distributed to the system microprocessor, which determines what function(s) to activate. Input from the pushbuttons on the front and rear panels are arranged in a matrix of five columns (CAS 1 through 5) and three rows (RAS 1 through 3). The system microprocessor functions as a multiplexer, providing a high logic level for each row. In this way, the system microprocessor senses any closed column switch.

Audio Alarms. The system microprocessor switches the audio alarm on and off and controls the volume. A piezoelectric transducer on the Interconnect

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PCB produces an audible tone in response to input from the system microprocessor. An internal oscillator in the system microprocessor provides four tone frequencies, including the key-click response when a pushbutton is pressed. Three output lines, VOL CONTROL BIT (1 thru 3), produce eight volume levels. The audio is silenced by turning off the system microprocessor's internal oscillator.

Charge Control. The system microprocessor initiates and monitors charge requests to the D/A converter U18 on the Power Conversion PCB. I/O CLOCK, CONVERTER FUNCTION SELECT, CONVERTER DATA IN, and CONVERTER DATA OUT lines accomplish serial communication with the D/A converter. Pressing CHARGE on the keypad transmits the coded selected energy value from the system microprocessor to the Power Conversion PCB over the CONVERTER DATA OUT line. Status information on the decoding process on the Power Conversion PCB is sent back to the system microprocessor over CONVERTER DATA IN. The I/O CLOCK provides synchronous timing for serial communication.

Following the charge initiation, the system microprocessor runs a set of self-tests. These self-tests are completed before the selected energy is available. If self-test fails, the CRT displays the SERVICE legend.

The energy stored on the energy storage capacitor is monitored through a 10-bit analog-to-digital (A/D) converter located on the Power Conversion PCB. The A/D converter shares the four-line, serial-communication interface with the D/A converter. If the system microprocessor indicates that the energy stored is out of tolerance, an ENERGY FAULT message is displayed. The system microprocessor controls the CONVERTER FUNCTION line and controls whether the communication is with the D/A or the A/D converter, since they share the same communication lines.

I/O Protection. Electrostatic discharge protection is provided by the resistors and capacitors on all the I/O lines that run off the Main PCB. Additional protection is provided by 6.2V zener diodes, CR7 through CR9, on the VIDEO 1, VIDEO 2, and RASTER lines directed to the Monitor PCB.

Display/Recorder Interface

Display Recorder Controller. The central component of this circuit is the display/recorder microprocessor U1. It receives the digitized ECG signal data from the system microprocessor and controls the input of this data to the Display Assembly CRT and the recorder. Because the CRT screen resolution is not as high as the recorder resolution, the display/recorder microprocessor compresses ECG data for the CRT display. The recorder receives all incoming ECG data samples. The display/recorder microprocessor also formats the ECG data so waveforms do not have gaps or overlapping segments on the CRT screen.

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ECG sample data is transmitted from the system microprocessor to the display/recorder microprocessor through the Tx serial communication line approximately every 1.8ms. Other data/command bytes from the system microprocessor bulletin board are also transmitted to the display/recorder microprocessor when they are required for a particular function. This data is transmitted in packets containing a header byte, followed by two ECG sample bytes and, if required, a data/command byte from the system microprocessor.

The first four I/O lines listed in Table 1–4 communicate with the Display Gate Array, driving the input for the display on the Monitor PCB. The other five I/O lines control the operation of the recorder. Refer to schematic, page 5–26.

Table 1–4 Display/Recorder Microprocessor I/O Lines

I/O Line	Signal	Direction
$\overline{IRQ1}$	$\overline{H.RETR}$	In
P52	GO	Out
P53	$\overline{INCMEM}$	Out
P54	TR/$\overline{CHAR}$	Out
P21	STROBE	Out
P60	RCRDR.PWR	Out
P61	PRNTHD.CURR.SNS	In
P66	PRINTHD.TYPE	In
P67	PRINTHD.LOAD	Out

System Clock. Crystal-controlled multiple-output oscillator U10 provides a 16MHz square wave to the Display Gate Array. It also supplies 8MHz to both the system and display/recorder microprocessors (U30 and U1), and 2MHz to A/D converter U9 on the Power Conversion PCB.

Address Decode. Programmable logic array U9 controls the reading from and the writing to all external memory and the recorder gate array, U3. It is used as an address decoder and is programmed to enable certain devices when the display/recorder microprocessor addresses different areas in memory. U9 is permanently programmed passing only the desired data to the devices being addressed.

Buffers U11, U12, and U15 isolate the appropriate RAM/ROM memory devices from interaction with the display/recorder microprocessor. U11 buffers the data bus. Buffers U12 and U15 control interaction on the address

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bus between the display/recorder microprocessor, the Display Gate Array, and the RAM/ROM memory devices.

Display Gate Array. Display Gate Array U29, is a custom IC containing many blocks of standard OR and AND gate circuits (counters, multivibrators, flip-flops, etc.). A metallic layer added on top of the gate circuits connects circuits for: Monitor PCB sync timing, ECG memory addressing, ECG display trace generation, video intensity, and additional timing signal generation. Two different internal counters control the timing of the Video RAM and Font EPROM addressing during CRT scan periods, and control the Video RAM addressing during CRT retrace periods.

The Display Gate Array uses an 18-bit counter to control the timing of the vertical and horizontal retrace on the Display CRT. The lower 8 bits correspond to 256 rows and the upper 10 bits correspond to 768 columns (scan lines). When a count of 256 occurs, the gate array initiates a vertical retrace. When a count of 196,608 (256 x 768) occurs, the gate array starts horizontal retrace.

Four separate memory loops for two separate trace generators in the Display Gate Array format the ECG signal in memory. Formatting occurs during horizontal retrace. An internal 11-bit counter addresses each memory loop. Each trace generator, uses one memory loop for the high point of the scan and another memory loop for the low point of the scan. The trace appearing on the CRT screen is created by turning the video on at the screen location that corresponds to the low point, and turning the video off at the screen location that corresponds to the high point. The only data loaded in memory are the high and low point addresses for each scan, saving memory space in Video RAM U21.

Serial communication between the Display Gate Array and the display/recorder microprocessor is accomplished by the following control lines: H.RETR, GO, INCMEM, and TR/CHAR. These lines enable the Display Gate Array and the display/recorder microprocessor to coordinate the storage and retrieval of ECG and character data in the Video RAM during horizontal retrace. Figure 1–7 shows the control line timing sequence.

Data from the display/recorder microprocessor loads into the Video RAM memory during horizontal retrace. Six ECG samples update during horizontal retrace to smooth scrolling of the trace displayed on the CRT monitor. Coded character address data used by the Font EPROM also loads into the video RAM at this time.

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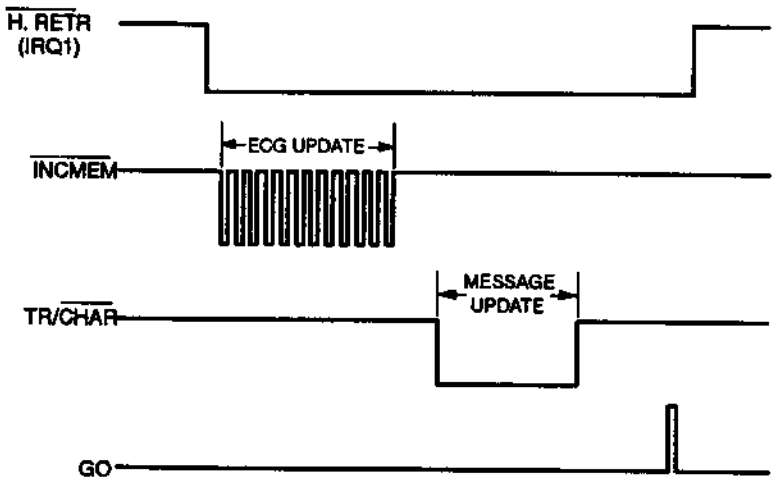

Figure 1–7 Control Line Timing

ECG trace and messages display during raster scan. The Video RAM sends ECG data to the Display Gate Array through EDAT(0–7); character address information passes to the Font EPROM through DD(0–7). Character pattern data stored in the Font EPROM is addressed and routed to the Display Gate Array as CDAT(0–7). The Display Gate Array sends the character data out to the proper address on the display (see Figure 1–8).

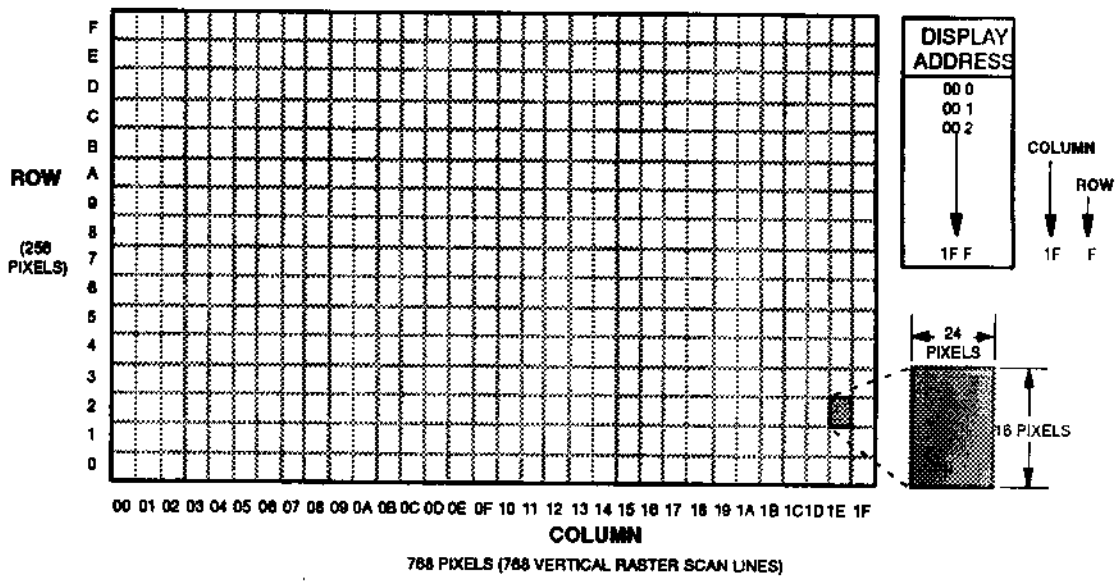

Figure 1–8 Character Cell Locations

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The Display Gate Array also functions as a video intensity circuit, producing four levels of brightness for the trace and characters. Two video outputs from the Display Gate Array, VIDEO1 and VIDEO2, generate the appropriate brightness level for the digitized display data by transmitting the data in a two digit code to the Video Signal Amplifier circuit on the Monitor PCB. This code determines if the addressed pixel will be at full intensity, normal video, half-tone, or off (see Figure 1–9). Half-tone is used only for the end points of the ECG waveform segments; full brightness is used only for the sync marks. The rest of the ECG waveform and all the characters are transmitted with normal brightness.

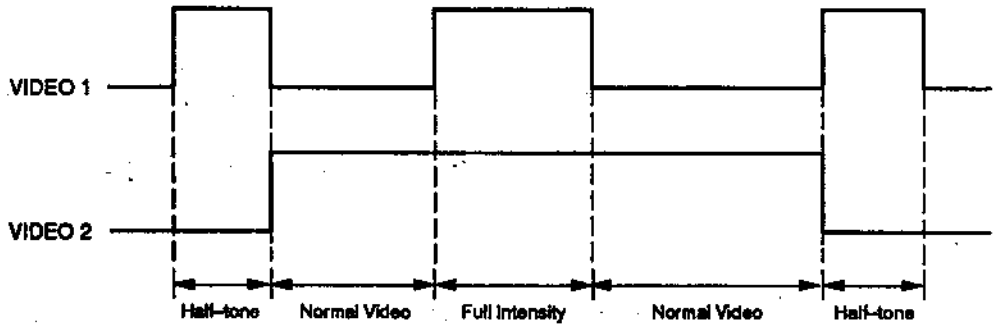

Figure 1–9 Video Intensity

Character dot information merges with trace information to create the video input signal. Messages have priority over waveforms when the two types of data are mapped to the same point on the CRT.

Video RAM. Trace and character data are stored in a 32k x 8 static RAM U21. New ECG data is installed during the horizontal retrace and consists of twelve bytes. Horizontal retrace provides an interrupt to the display/recorder microprocessor which signals permission for a memory access. The display/recorder microprocessor stores new data and increments the memory address counter.

An additional 512 bytes are used for storage of the character address codes (similar to ASCII codes). The screen can be configured into a matrix of 16 x 32 character cells, each cell accepting character information from the Font EPROM. The message content is updated as needed by the display/recorder microprocessor during horizontal retrace.

Font EPROM. A 32k x 8 EPROM U22 contains character font patterns, with memory for 256 characters. Each character is 16 pixels high and 24 pixels wide to fit in the screen character cells (see Figure 1–8). The displayable character set includes single-sized numerals, punctuation, and uppercase letters in normal, inverse, and boldface video. Special characters and double-sized numerals are in normal video display.

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Program EPROM. Another 32k x 8 EPROM U14, contains the operating software for the display/recorder microprocessor. Included in the software is a list of codes representing all of the words and phrases used in the annotated recorder text.

Program RAM. The Program RAM U13 is used by the display/recorder microprocessor as a scratch-pad while performing program functions. Additionally, all CODE SUMMARY data and the display/recorder microprocessor bulletin board is stored in the Program RAM.

Recorder Power. The Recorder Power circuit provides operating voltage for the Printhead and the Motor Speed Control circuits by responding to a high logic signal from the display/recorder microprocessor at the base of Q2. This logic signal causes Q2 to conduct, turning on Q4, supplying power for the recorder motor and printhead.

Motor Speed Control. Regulation of the recorder speed is necessary because of the variable drag on the recorder motor caused by the thermal printhead and the lack of a spindle on the paper roll. The paper speed of the recorder is regulated by a variable-frequency, pulse-width-modulation circuit that compares the back-EMF (electromotive force) on the motor to a reference voltage. If an adjustment is needed, the circuit varies the frequency of the motor speed drive pulse enough to maintain the 25mm/s paper speed.

The back-EMF produced in the motor when the drive pulse switches off determines the speed of the recorder motor. The voltage present at voltage dividers R18, R17, and C4 is directly proportional to the speed of the motor when Q3 is off.

A frequency-modulated pulse from transistor Q3 drives the recorder paper motor. The pulse has a fixed on-time and a variable off-time. The off-time is set by comparator U2B and capacitor C4 and determines how much power Q3 conducts to the paper motor.

The fixed on-time is determined by U2C. C2 charges to about 75% of VBATT during the off-time period. At the next on-time cycle, the output of U2B switches to ground, U2C pin 10 goes to about 1/3 of VBATT, and C2 starts discharging through R7. U2C changes states and ends the pulse on-time when the voltage on C2 drops below the voltage on pin 10.

Off-time is determined by comparing the voltage on U2B pin 7 to a calibrated reference voltage at pin 6. During the on-time, C4 is charged to a voltage proportional to the battery voltage. During the off-time, C4 discharges toward a voltage that is proportional to the back-EMF of the motor. Under normal operating conditions, the voltage on C4 discharges over several time constants before the voltage on U2B pin 7 is equal to the reference voltage on pin 6. When the voltages are equal, the output of U2B

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switches low and Q3 conducts, supplying voltage to the paper motor. As the load on the motor increases, the back-EMF voltage decreases and the pulse-width off-time gets shorter.

Printhead Control. Control of the data to the recorder printhead is accomplished by the display/recorder microprocessor in conjunction with recorder gate array U3, program RAM U13, and program EPROM U14. The display/recorder microprocessor receives data from the system microprocessor and formats it for transmission to the recorder printhead.

The recorder gate array receives parallel data from the display/recorder microprocessor and transmits this data in serial form to the recorder printhead. The printhead prints an array of 384 bits from top to bottom of the recorder paper. The recorder gate array translates the two ECG signal data bytes from hexadecimal code to the 320 bits required by the printhead. Bytes for generating hexadecimal characters are mapped to the remaining 64 bits (32 for the top, 32 for the bottom) since text for the recorder always appears at fixed locations at the top or bottom of the recorder paper. As in the Display Gate Array, two internal trace generators receive high and low address inputs for the ECG trace and the SYNC marks.

The thermal printhead is an array of 384 switches and dots. An internal 384 bit shift register (see Figure 1–10) receives data input to the printhead. The recorder gate array sends clock pulse CK to the printhead, which enters data on the DI line into the shift register and converts the data from serial to parallel. The CK pulse is active only when data is sent to the printhead, preventing the printhead shift register from running continuously. The source of the CK pulses is the E clock used by the system microprocessor and the display/recorder microprocessor.

The display/recorder microprocessor moves the data stored in the printhead shift register into the printhead latch LD line. Data in the shift register is loaded into a 384 bit latch with a high LD signal from the display/recorder microprocessor. The output of the latch is gated by 384 AND gates; the drive for the dot heating elements is provided by 384 NPN transistors. After the data is loaded into the latch, the display/recorder microprocessor STROBE line switches one input of the AND gates high. This causes the gates switched high (data =1) on the other input to switch their outputs high. The selected transistors conduct, drop a voltage across their respective heating elements, and activate the selected printhead dots.

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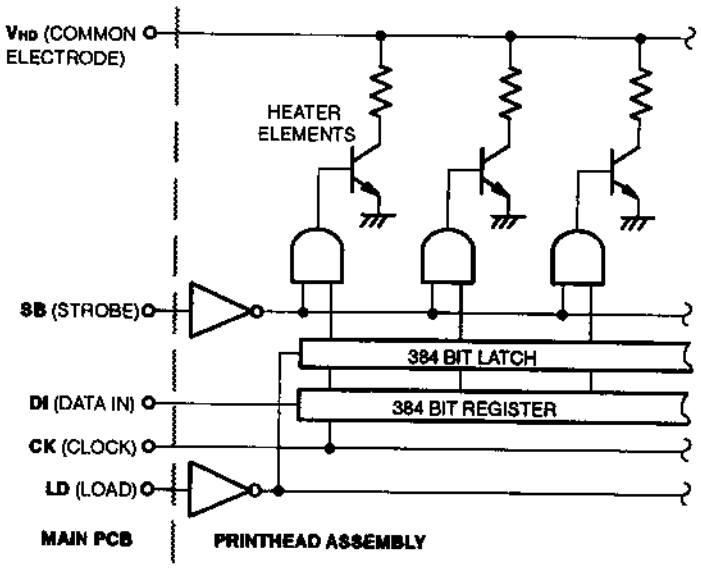

Figure 1–10 Printhead Assembly

Printhead Resistance Evaluation. The Printhead Resistance Evaluation circuit is active only when the instrument is in motor speed calibration mode. When the motor speed calibration test runs, the display/recorder microprocessor starts energizing the printhead dots.

Measured printhead resistance, printhead temperature, and voltage during printing determine the optimum duty cycle of the printhead. The printhead duty cycle is the time period that the printhead dots are energized. This is regulated by the width of the printhead strobe pulse, SB (see Figure 1–10). If the strobe pulse is too short, the print will be light; if it is too long, the excessive heat on the dots will greatly shorten the life of the printhead. The system microprocessor (U1) collects the printhead resistance, the battery voltage, and the printhead temperature, and calculates the optimum printhead strobe width.

Monitoring the current through the printhead while increasing the number of dots turned on determines the printhead resistance. As the number of dots turned on increases, the combined resistance of the printhead decreases. Comparator U2A monitors the load on the VHD line at pin 5, through current sense resistor R27 and voltage divider R13 and R16. The VBATT line is monitored at pin 4, through voltage dividers R10 and R15. As the load on the printhead increases, the voltage across R16 decreases. When the voltage across R16 drops lower than the voltage across R15, U2A switches low. This directs the display/recorder microprocessor to stop sending strobe signals to the recorder gate array at the $\overline{\text{STROBE}}$ input. The display/recorder

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microprocessor then determines the printhead resistance from the number of dots turned on and passes this information to the system microprocessor.

A thermistor in the recorder produces a voltage that varies with the printhead temperature. This voltage is routed to A/D converter U9 on the Power Conversion PCB. The converted temperature voltage and the battery voltage are read by the system microprocessor from U9. The system microprocessor also receives the printhead resistance data from the display/recorder microprocessor and calculates the optimum strobe width from these three parameters. The data code representing the optimum strobe width is then transmitted to the display/recorder microprocessor.

Display Assembly (803706)

The Display Assembly (Figure 1–11) contains a CRT and a Monitor PCB Assembly.

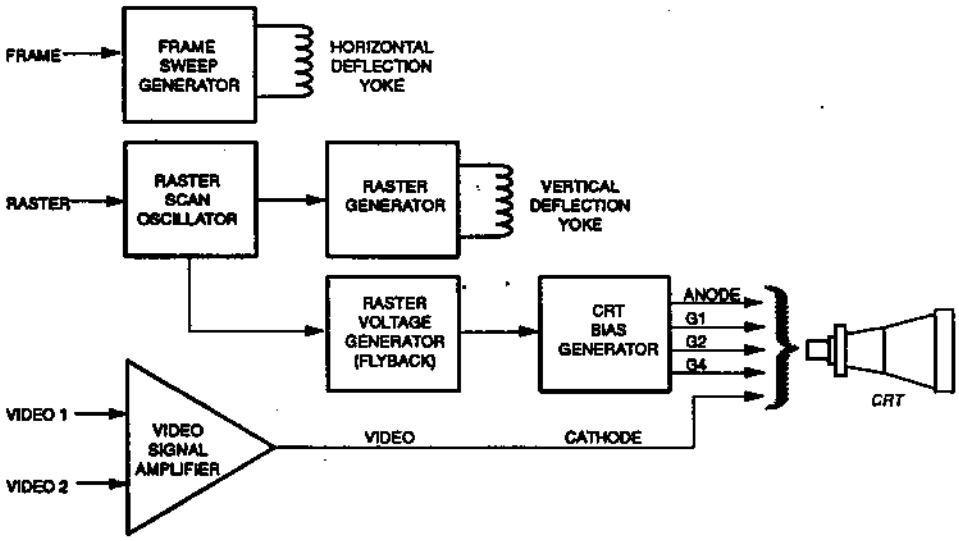

Figure 1–11 Display Assembly Block Diagram

The Monitor PCB Assembly processes video information and synchronization signals from the Main PCB Assembly and transmits them to the CRT. These signals are VIDEO 1, VIDEO 2, and synchronization signals FRAME SYNC and RASTER SYNC. Two separate circuits provide horizontal and vertical CRT beam deflection. The CRT raster consists of 768 scan lines in one complete frame and 256 pixels per line. The CRT screen is scanned by a vertical raster, bottom to top, left to right (see Figure 1–12). There is no interlacing during the raster scan.

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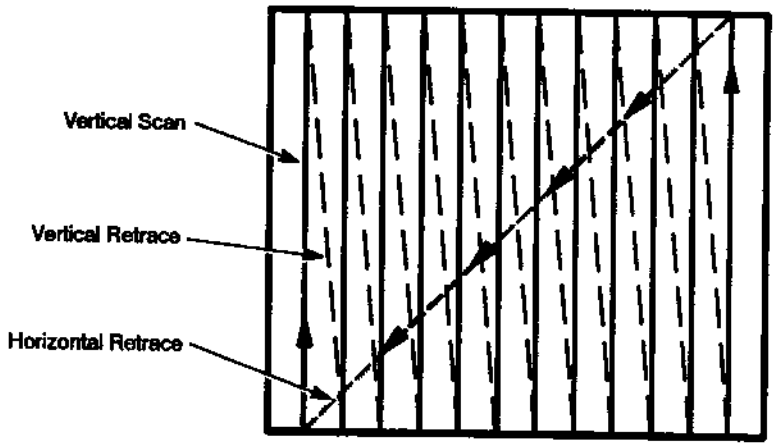

Figure 1–12 Display Scanning

Video Signal Amplifier

This circuit receives video information at VIDEO 1 and VIDEO 2 inputs, controlling voltage to the CRT cathode at the video output (J902 pin 2). The input to VIDEO 1 and VIDEO 2 is supplied from the Display Gate Array on the Main PCB at TTL levels (J4). The outputs of U401A, U401B, and U401C provide biasing for Q401, causing Q401 to conduct and supply a nominal +40V to the video output. Four levels of video intensity are available by switching the outputs of U401A, U401B, and U401C. Brightness is adjustable through Video Gain Adjust, R402.

Frame Sweep Generator

A deflection hybrid IC, U101, drives the frame yoke to sweep the CRT during horizontal retrace. The Display Gate Array on the Main PCB supplies the synchronizing signal (about 60Hz), FRAME SYNC, for this circuit.

To sweep the CRT accurately, U101 requires biasing by a number of external components. The RC combination, R105, R106, and C102, sets the frequency of the hybrids internal oscillator. Horizontal Hold R106 is adjusted to prevent the display from rolling. R111 provides a width adjustment and R113 calibrates the CRT beam linearity. R128 senses deflection current and feeds back to U101 pin 10 to help control both width and linearity. R117 and C112 form a damping circuit to eliminate yoke ringing (oscillation).

Raster Scan Oscillator

The Raster Scan Oscillator sets the sweep frequency for the Raster Generator and the switching frequency for the Raster Voltage Generator power supply. The circuit is designed around voltage regulator U201.

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The voltage regulator oscillator frequency is set by the RASTER signal at about 52kHz. This signal is sent from the Display Gate Array on the Main PCB to Q201, causing Q201 to conduct and pass the signal to U201 pin 5. Resistor R217 and capacitor C203 function as an RC network, slowing the current at power-on. Resistor R209 decouples the +15V supply voltage so that display size will be minimally affected by changes in the +15V supply.

Input over-voltage protection is provided by Q201, Q202, and D201. If the input voltage climbs to 18V or greater, D201 starts to conduct. This signal forward biases Q203, which routes it to the gate of Q202. When Q202 conducts, it inhibits the internal oscillator in U201 by applying +5V to the input at pin 4.

Vertical Size adjustment is controlled by R224. Vertical Size controls the width of the pulse from the output stage of U201, which determines the amount of energy delivered to transformer T301.

Raster Voltage Generator

The Raster Voltage Generator supplies the input voltage for the primary of T301, and provides overall CRT bias voltages as well. The input signal for the circuit comes from the output of voltage regulator U201 pin 10, the Raster Scan Oscillator circuit.

The Raster Voltage Generator circuit is designed around transformer T501 and transistors Q501 and Q502. The oscillating output of U201 drives Q501, providing additional current for Q502. The output of Q502 sets the voltage for the primary of T301. The +15V input at T501 pin 4 produces ±15V (30V total) output at pin 5. A tap at T501 pin 6 supplies +24V. The secondary winding on T1 adds +14V to boost the +24V to +40V output at T501 pin 8. This voltage provides a ground reference for biasing grid 2, grid 4, and to a lesser extent, grid 1.

Raster Generator

Vertical deflection for the raster yoke is provided by the Raster Generator circuit. Because of high current and voltage requirements, the vertical deflection circuit consists of discrete components, forming a resonant circuit. The Raster Generator, like the Raster Voltage Generator, is driven from the Raster Scan Oscillator circuit. The Raster Generator circuit includes transformer T301, which is shared with the CRT Bias Generator and provides the drive signal for the 88mH yoke coil. This creates the vertical scan drive for the CRT.

The Display Gate Array on the Main PCB supplies the synchronizing signal, RASTER SYNC, which is passed to voltage regulator U201. The output of U201 pin 9 causes Q204 to conduct, providing additional current for Q205. The output of Q205 controls the charge and discharge of C208 through C212. The precise values of these capacitors are essential for maintaining the proper

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resonance while charging and discharging. Transformer T301 provides high voltage for charging the capacitors.

CRT Bias Generator

The CRT Bias Generator supplies half-wave rectified voltage for the CRT anode and grid from the output of transformer T301. It provides up to –150V for bias of G1, up to +700V for bias of G2 and G4, and between +8.5kV and +11.6kV for anode bias. R302 adjusts the brightness which determines the general background brightness of the CRT. R306 adjusts the focus. R315 is a secondary brightness control for fine adjustment of the CRT background.

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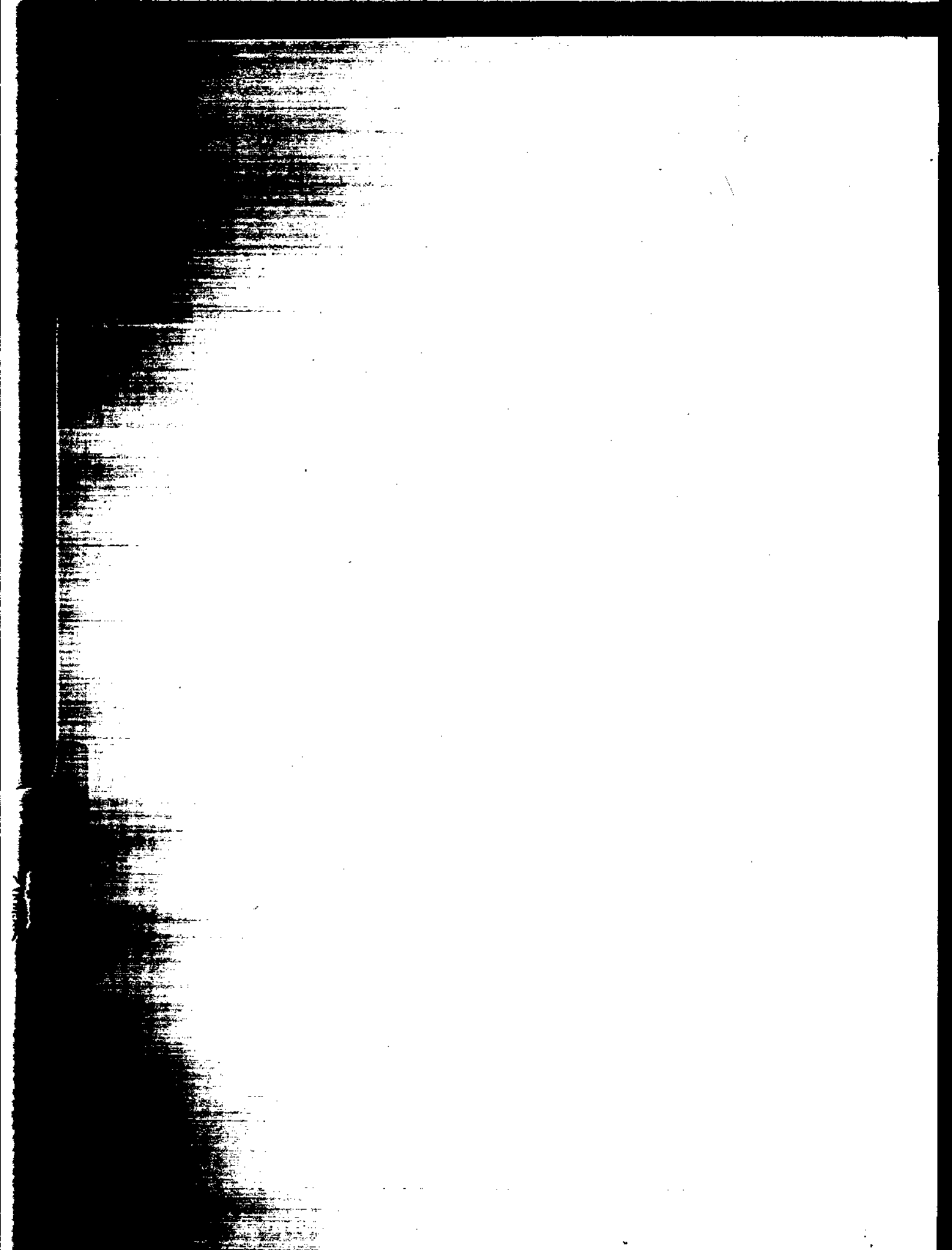

Operations 2

Introduction

This section provides information about the basic operation of the instrument. It is not intended to instruct an operator in the clinical use of the instrument; refer to the separate *Operating Instructions* for that information. Basic information provided in this section covers:

- Front Panel Controls and Indicators, including Paddles Area
- Rear Panel Controls and Indicators
- Set–up and Info Options
- Clock Setting Procedures.

Controls and Indicators

LIFEPAK 9 defibrillator/monitor controls and indicators are identified in Figures 2–1 and 2–2 and corresponding Tables 2–1 and 2–2.

> *Note:* *Pushbuttons are indicated in* CAPITAL LETTERS *and displayed messages are indicated in* **BOLD CAPITAL LETTERS.**

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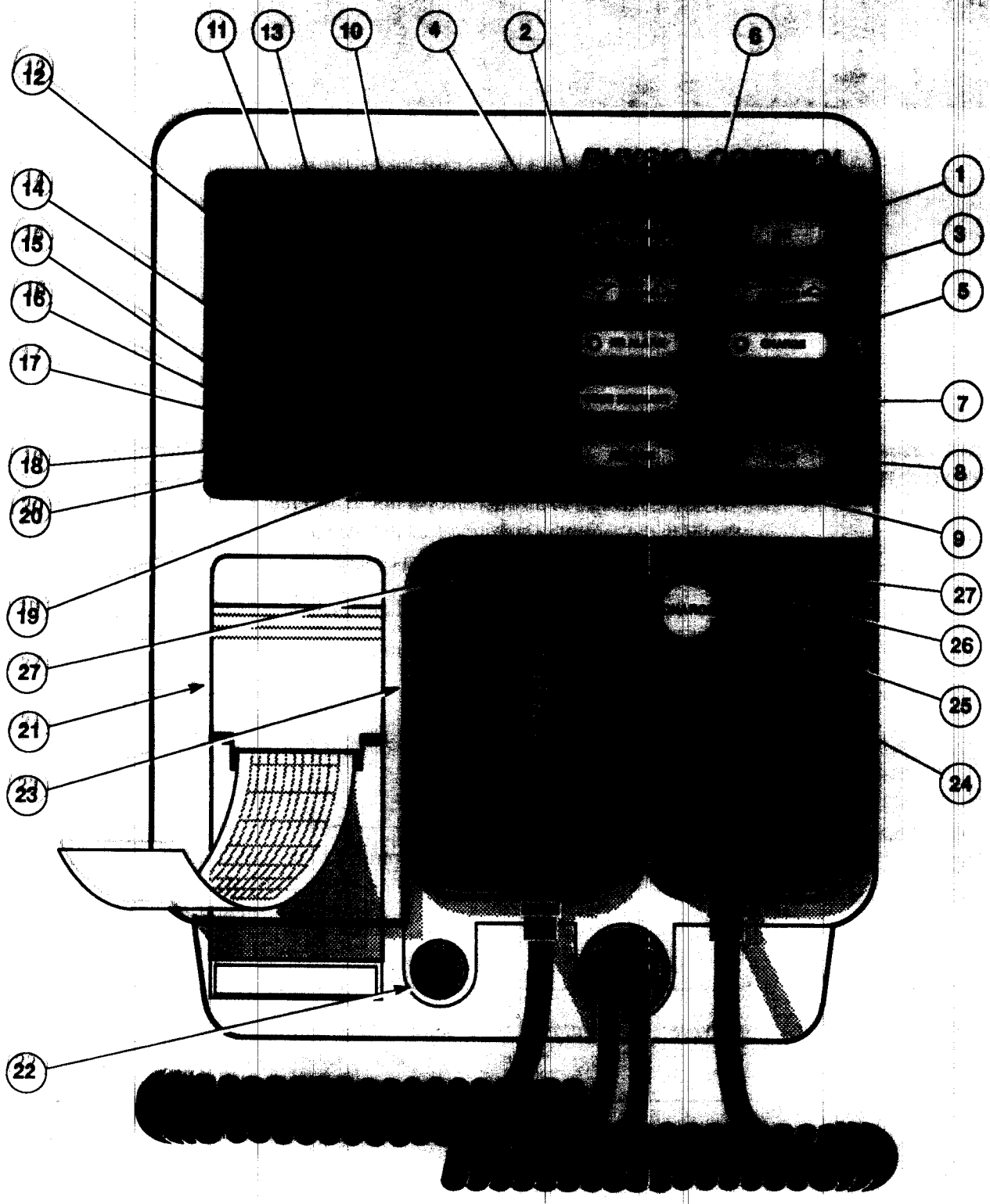

Figure 2–1 Front Panel Controls and Indicators

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Table 2–1 Front Panel Controls and Indicators

Item	Control or Indicator	Function
1	ON	Toggles instrument power on and off. Power–on illuminates the LED.
2	LEAD SELECT	Selects **PADDLES** input or patient cable leads (**STD, LEAD I, LEAD II,** and **LEAD III**). Switches the selected lead display to reverse video and advances to the next lead selection. Defaults to **LEAD II** at power–on unless **PADDLES** is specified in the **SETUP** menu.
3	▼ ENERGY ▲ SELECT	Displays the energy selection range incrementally. Select **LOW** on the high range menu to display the low range selections from 0 to 9 joules. Select **HIGH** on the low range menu to display the high range selection from 0 to 360 joules. Selecting 0J inhibits energy charging. Pressing during charging or prior to energy transfer internally dumps stored energy.
4	▼ ECG ▲ SIZE	Changes the displayed ECG size to reverse video and increases or decreases the gain by one setting. ECG size is adjustable from 0.2cm/mV to 4.0cm/mV. Defaults to gain of **X1.0** at power–on. Affects gain of ECG OUTPUT.
5	CHARGE	Initiates defibrillation charge cycle. Existing defibrillator status message is replaced with **XXX JOULES CHARGING** message, where XXX displays the stored energy as it ramps up to the selected value. LED flashes during charge. At charge completion **XXX JOULES AVAILABLE** message displays while LED remains on steadily.
6	HR ALARM	Displays the preset alarm limits in reverse video and lights the LED. Incrementally steps through the three default limit selections (150/40, 120/60, and 160/90), or the values set by the operator in the **SETUP** menu when pressed again.
7	CODE SUMMARY	Starts the recorder and produces a summarized printout of critical events (defibrillation/cardioversion and selected ECG segments). Stops recorder when pressed again.
8	SYNC	Activates sync mode message display and LED light. LED flashes with each QRS detection. Returns to defibrillate (asynchronous) mode when pressed again. Also used in the test mode option.

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Table 2–1 Front Panel Controls and Indicators

Item	Control or Indicator	Function
9	RECORD	Toggles the recorder on and off.
10	Cardioscope	Nonfade CRT display. ECG trace moves from right to left.
11	QRS Indicator	Heart symbol flashes with each QRS detection.
12	Heart Rate	Displays digital QRS rate (20bpm to 300bpm).
13	Heart Rate Alarm Limits	Display indicators for high/low alarm settings which cannot be adjusted during normal operation. Limits flash if violated and alarm sounds.
14	Trace	Nonfade display trace moves from right to left.
15	Lead Select Indicator	Display indicates lead selected.
16	Calibrated Gain	Display indicates actual gain selected.
17	Status Message Display	Indicates instrument status: **SYNC MODE, FOR SYNC: USE LEADS, NO PAPER, LOW BATTERY: CONNECT AC POWER,** and **SERVICE.**
18	Energy Selection Display	Menu for high energy selection range shown. Select **LOW** to display menu for low energy selection range. Energy selection range stays on screen for 10s following the last energy level selected or until pressing another pushbutton.
19	**JOULES SELECTED** Indicator	On–screen indication of energy level selected in joules. Number scrolls up as energy is stored. Defaults to 200J at power–on.
20	**BATT CHRG** Indicator	LED indicates battery is charging.
21	Recorder	Records ECG and annotation in delay ECG mode only. Prints date, time, sync mode (if active), ECG lead, ECG gain, and heart rate. Prints selected energy and defibrillate mode during defibrillation. Prints automatically for 16s whenever alarm violation occurs.

Table 2–1 Front Panel Controls and Indicators

Item	Control or Indicator	Function
PADDLES AREA		
22	Patient Cable Connector	Connection for 6–pin patient cable. Use only Physio–Control 3–lead patient cable part number 9–10418.
23	STERNUM Paddle	Defibrillating electrode with one discharge pushbutton, usually placed to left of sternum (patient's right). Also serves as negative ECG electrode during QUIK–LOOK paddle monitoring.
24	APEX Paddle	Defibrillating electrode with QUIK–CHARGE control (CHARGE) and second discharge pushbutton, usually placed near cardiac apex. Also serves as positive ECG electrode during QUIK–LOOK paddle monitoring.
25	CHARGE (QUIK–CHARGE control)	Charges defibrillator from APEX paddle.
26	Charge Indicator	LED flashes during charge and glows steadily when energy has reached selected level.
27	Discharge Pushbuttons	Discharges energy. Both pushbuttons must be pressed simultaneously to deliver energy to the paddles. Energy will not be delivered unless the instrument is fully charged to selected level.
28	Test Load	50W defibrillator test load. Metal contacts (not shown, in paddles storage area) for receiving 200J defibrillation pulse from paddles.

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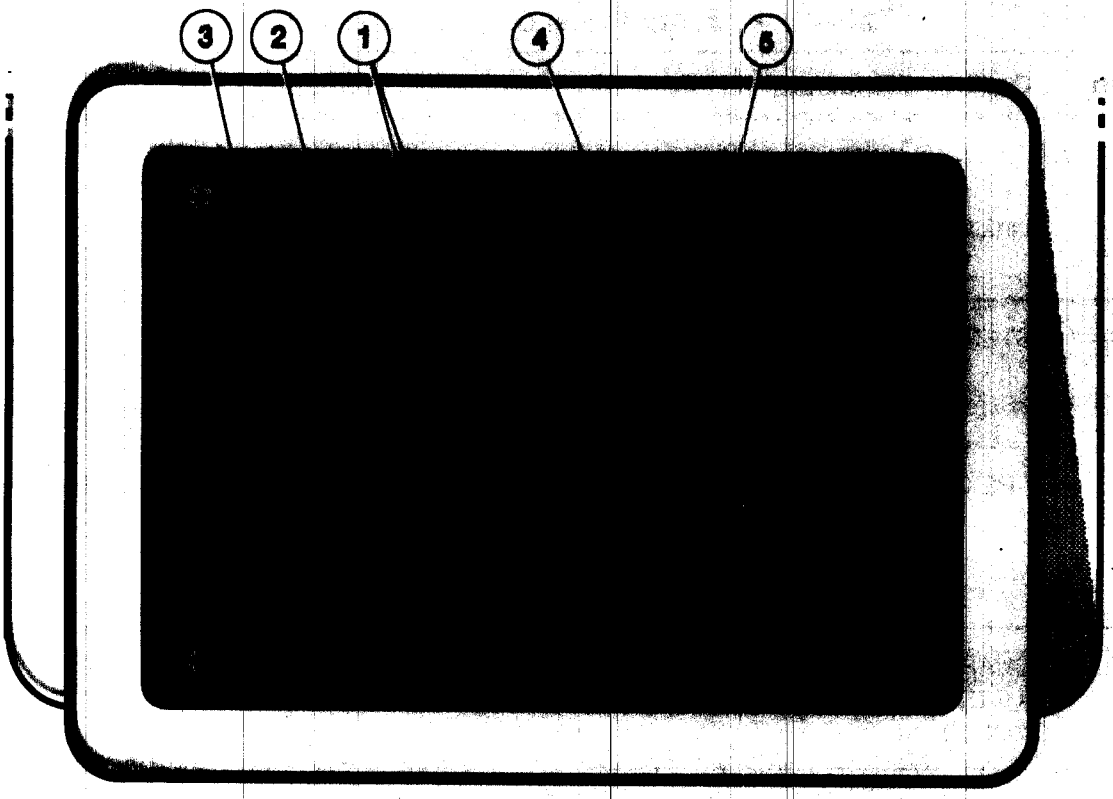

Figure 2–2 Rear Panel Controls and Indicators

Table 2–2 Rear Panel Controls and Indicators

Item	Control or Indicator	Function
1	TIME/DAY	Pushbuttons for setting the real–time clock.
	MODE	Pressing the pushbutton once selects the clock set mode. Pressing repeatedly selects minutes, hour, year, month, and day fields. Press again to remove clock–setting display from the screen.
	SET	Pressing the pushbutton advances the data of the selected clock–set field. After the highest value is reached, it rolls over to the lowest value.
2	▼ QRS VOL ▲	Pressing the up or down scroll pushbutton increases or decreases the QRS volume. Setting at power–on is the same volume selected when the instrument was last turned off.
3	1mV CAL	Displays a 1mV calibration signal on the CRT and recorder.
4	Ground	Equipotential ground tie point
5	ECG OUTPUT	ECG out connector; 1V/1mV with gain of 1 (see ▼ ECG SIZE ▲ to set gain)

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Options

The LIFEPAK 9 defibrillator/monitor contains software for changing instrument settings, clearing or retaining stored data, and initiating selected tests. These options are selected from the test mode **SETUP** and **INFO** menus. Refer to Section 3, page 3–18 for more information about test mode menus.

Setup

1. To access the setup menu, the instrument must be off. If the instrument is on, press ON so the green LED goes off.

2. Simultaneously press and hold LEAD SELECT and HR ALARM, then press ON.

3. Continue holding LEAD SELECT and HR ALARM until the message **SELECTED TEST:** and a list of options appear on the CRT. This list is the top–level menu. Refer to Figure 2–3.

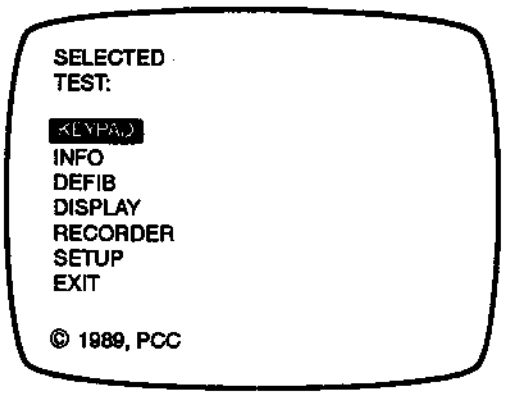

Figure 2–3 Top–Level Menu

4. Press ▼ ECG SIZE ▲ to scroll through the top–level menu. Scroll to **SETUP** and select by pressing HR ALARM.

5. Press HR ALARM to scroll through the available selections. Press ▼ ECG SIZE ▲ to change the options. Refer to Figure 2–4.

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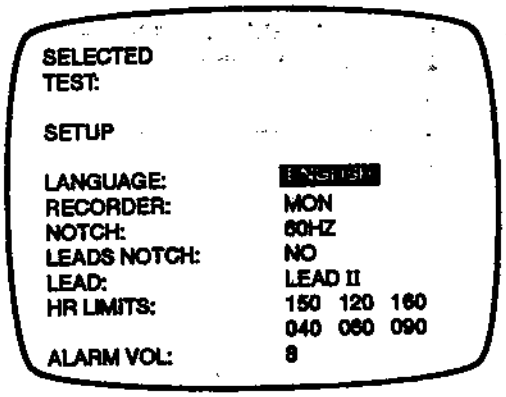

Figure 2–4 Setup Menu

Select from these parameters to reconfigure the instrument:

LANGUAGE:	**ENGLISH, FRENCH, GERMAN, or SPANISH**
RECORDER:	**MON**itor or **DIAG**nostic
NOTCH:	**50Hz** or **60Hz**
LEADS NOTCH:	**YES** or **NO**
LEAD:	**PADDLES** or **LEAD II**
HR LIMITS:	3 ranges can be configured from the following limits: 80bpm to 240bpm /upper limit (top row) and 20bpm to 100bpm/lower limit (bottom row).
ALARM VOL:	1 to 8 (A short tone sounds with each level change.)

6. Press HR ALARM until the menu returns to **LANGUAGE:** (to enter selection).
7. Press LEAD SELECT to return to the top–level menu.
8. Scroll to **EXIT** and press HR ALARM to resume normal operation.

Info

1. To access the info menu, the instrument must be off. If the instrument is on, press ON so the green LED goes off.
2. Simultaneously press and hold LEAD SELECT and HR ALARM, and then press ON.

3. Continue holding LEAD SELECT and HR ALARM until the message **SELECTED TEST:** and a list of options appear on the CRT. This is the top–level menu (refer to Figure 2–3, page 2–7).

4. Press ▼ ECG SIZE ▲ to scroll to **INFO.** Access the **INFO** menu by pressing HR ALARM.

5. Press HR ALARM to scroll through the available selections. Press ▼ ECG SIZE ▲ to toggle **CLEAR** or **RETAIN.** Refer to Figure 2–5.

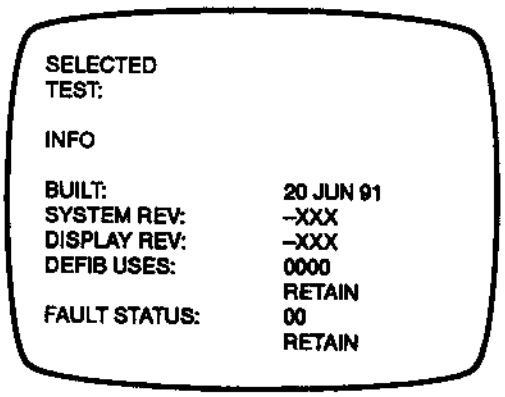

Figure 2–5 Info Menu

BUILT: Displays the manufacturing date and cannot be changed.

SYSTEM REV: Displays the revision number for the system microprocessor EPROM and changes automatically with any EPROM update.

DISPLAY REV: Displays the revision number for the display/recorder microprocessor EPROM and changes automatically with any EPROM update.

DEFIB USES: Counts the number of defibrillator discharges and allows the operator to **RETAIN** or **CLEAR** the number.

FAULT STATUS: Retains any coded instrument errors using the error codes listed in Section 3, Table 3–5, page 3–30. Operator may **RETAIN** or **CLEAR** codes.

Clock Setting Procedure

The MODE and SET pushbuttons on the rear panel (page 2–6) of the instrument set the date and time displayed on the CRT and the recorder. Refer to Figure 2–6.

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1. Press MODE to initiate the clock setting mode.
2. Press MODE again to successively select the minutes, hour, year, month, and day fields.
3. Press SET to advance value in the selected field.
4. Press MODE again after selecting the day field to exit the clock setting mode.

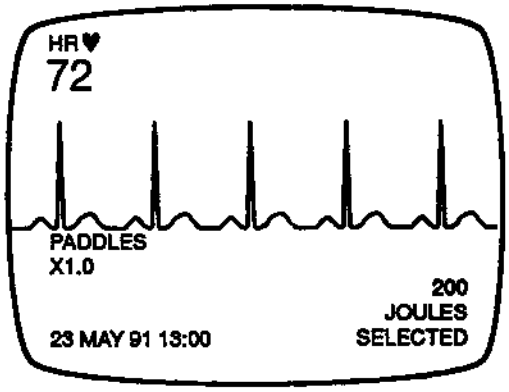

Figure 2–6 Clock Set Display

Test and Calibration 3

Introduction

This section provides the following information for the LIFEPAK 9 defibrillator/monitor:

- Performance Inspection Procedure (PIP), a closed–case test confirming basic instrument functions
- Test and Calibration Procedures, more extensive tests plus calibration requiring the instrument to be opened.

Performance Inspection Procedure (PIP)

Perform the PIP every three months and after any service or repair to check instrument performance. Refer to Test and Calibration, page 3–15 for specific circuit test procedures. A PIP Checklist (page 3–12) is provided for convenience and may be copied when needed.

The following items are needed to complete the PIP:

Equipment Required	Part Number or Specification
ECG Simulator	Dynatech 215A or equivalent
ECG Paper	Box of 3 rolls, PCC No. 804700–003
Energy Meter	Electronics Unlimited DT650A or equivalent
Stopwatch	Accuracy: ±0.25s
Metric Ruler or ECG Paper	Dempsey 431 or equivalent
Safety Analyzer	

> ***Note:*** *Pushbuttons are indicated in* CAPITAL LETTERS *and displayed messages are indicated in* **BOLD CAPITAL LETTERS.**

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Warning — **SHOCK HAZARD.** The defibrillator stores and delivers hazardous voltages. Test and service personnel must be familiar with this instrument before performing these procedures.

PIP–Physical Inspection

Visually inspect all controls, indicators, and displays on the LIFEPAK 9 defibrillator/monitor for cracks, dents, loose or missing hardware, damaged labels, and contamination from foreign substances. Inspect the physical condition of the ac power cord and patient cable. Make sure the battery door is completely latched.

PIP–Battery Charge Legend

Connect the instrument to the ac power source. Check that **BATT CHRG** illuminates.

PIP–AC Power

1. Press ON to power the instrument. Check that the ON LED illuminates.
2. Check that within 10s after the instrument is turned on, **© 1989, PCC** displays for at least 5s.
3. Check that the power–on display appears on the CRT as shown in Figure 3–1 .

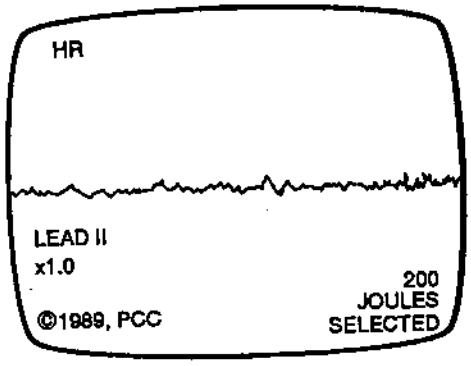

Figure 3–1 Power–On Display

PIP–Battery Power

1. With instrument power on, disconnect the power cord from the ac power source. Check that the instrument remains on and that **BATT CHRG** is off.
2. Reconnect the ac power cord, press ON to switch instrument power off.

PIP–Test Setup

1. Use the Setup Menu (see page 2–7, Options) to select:
   RECORDER: **DIAG**
   LEADS NOTCH: **NO**
2. Use default parameters for remaining selections.

PIP–Keypad Test

1. To initiate test mode, press and hold LEAD SELECT and HR ALARM (for more information on test mode refer to page 3–18).
2. Press ON. Continue holding LEAD SELECT and HR ALARM until the message **SELECTED TEST:** and a list of options appears on the display.
3. Scroll to the **KEYPAD** test using ▼ ECG SIZE ▲ and press HR ALARM to start the test.
4. Press all front, then all rear panel pushbuttons in the following order:

Front Panel:	**Rear Panel:**
LEAD SELECT	▼ QRS VOL
▼ ECG SIZE	QRS VOL ▲
ECG SIZE ▲	MODE
▼ ENERGY SELECT	1mV CAL
ENERGY SELECT▲	SET
HR ALARM	
CHARGE	
CODE SUMMARY	
RECORD	
SYNC	

5. Press the APEX paddle CHARGE pushbutton. Press the APEX paddle discharge pushbutton. Confirm that no beep sounds.
6. Press the STERNUM paddle discharge pushbutton. Confirm that no beep sounds.
7. Simultaneously press both paddle discharge pushbuttons. Confirm that a beep sounds.
8. Confirm that the CRT displays **KEYPAD: OK**. If the pushbuttons are not pressed in the order given or if there is a pushbutton failure, the CRT displays **KEYPAD: FAULT**.
9. Press LEAD SELECT to return to the top–level menu. Select **EXIT** and press HR ALARM to resume normal operation.

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PIP–Lead Select

1. Initial lead selection defaults to **LEAD II**. Check that repeatedly pressing and releasing LEAD SELECT consecutively displays **LEAD III, STD, PADDLES** and **LEAD I** in reverse video.
2. Use the patient cable to connect the ECG simulator to the instrument. Set the ECG simulator for a 60 beats–per–minute, normal–sinus–rhythm (bpm–NSR) signal.
3. Press LEAD SELECT and confirm that the signal is displayed in all lead configurations.

PIP–Recorder Speed/Baseline Centering

1. Place a new roll of ECG paper in the Strip Chart Recorder Assembly (see page 4–3, Loading Paper).
2. Set the ECG simulator for a 60bpm–NSR signal in LEAD II.
3. Press RECORD and let the recorder run for about 10s then select **STD**. Let the recorder run for an additional 10s.
4. Press RECORD to stop the recorder.
5. Measure the distance between the peaks of the recorded ECG trace. Check that the distance between consecutive peaks is 25mm ±1mm.
6. Measure the baseline centering of the recorded **STD** trace. Check that the baseline is centered within ±1.5mm.

PIP–ECG Display

Confirm that the flatline display on the CRT is level and centered from end to end. Check that all messages are visible.

PIP–1mV CAL

1. **LEADS NOTCH** must be deselected and recorder set to **DIAG** (see page 2–7, Options). Select **STD** lead.
2. Press RECORD, then press 1mV CAL on the rear panel once. Confirm that a 10mm ±0.5mm calibration pulse with less than 1.5mm overshoot is recorded (0.5mm overshoot if in **MON** mode). Refer to Figure 3–2.

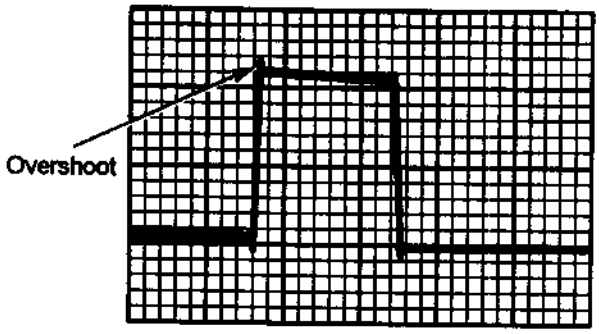

Figure 3–2 1mV CAL Pulse (DIAG mode)

PIP–CRT Gain/Aspect Ratio

1. Select **LEAD II**.
2. Set the ECG simulator for a 60bpm–NSR signal.
3. Adjust ▼ ECG SIZE ▲ for a 3.4cm ±0.2cm p–p ECG display signal.
4. Press RECORD.
5. Confirm that the signal amplitude recorded on the ECG paper is 2.0cm ±0.1cm.

PIP–Heart Rate

1. With **LEAD II** selected set ▼ ECG SIZE ▲ to **X1.0**.
2. Set the ECG simulator for the input rates listed. Check that the systole indicator flashes with each ECG waveform and that the displayed HR corresponds:

Input Rates	HR
30	30 ±3bpm
60	60 ±3bpm
240	240 ±7bpm

3. Return ECG simulator to 60bpm–NSR.

PIP–Rate Alarms/ Alarm–Activated Record

1. Press HR ALARM. Check that the HR ALARM LED is on and **150/40** is displayed in reverse video.
2. While the display is still in reverse video, press HR ALARM and check that **120/60** and **160/90** display consecutively.

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3. Select **150/40**. Check that after about 2s **150/40** displays in normal video.

> *Note: Heart-rate alarm limits can be changed. Refer to page 2–7, Options.*

4. Set the ECG simulator rate to 160bpm. Check that the alarm sounds, the **150** flashes, and the recorder runs for 16s.
5. Check that the heart rate recorded is 151bpm or higher.
6. Check that the displayed HR is**160** bpm ±5bpm.
7. Press HR ALARM and confirm that the alarm stops.
8. Decrease the ECG simulator rate to 30bpm. Press HR ALARM. Confirm that the alarm sounds, **40** flashes, and the recorder runs.
9. Press HR ALARM and confirm that the alarm stops.

PIP–Recorder Annotation

1. Set the ECG simulator to 60bpm.
2. Set the instrument to local time. See page 2–9, Clock Setting Procedure.
3. Press RECORD. The recorder annotates the date and time. Confirm that after this initial annotation, the recorder annotates heart rate, time, and date approximately every 20s.
4. Confirm that the time is accurate to within ±1min.
5. Change the lead setting to **LEAD III**.
6. Confirm that the recorder annotates the new lead setting along with the heart rate, time, and date.
7. Press RECORD to stop the recorder.

PIP–Test Load

1. Place the paddles in the paddle storage area of the instrument.
2. Press ▼ ENERGY SELECT ▲ if necessary to set the energy level to 200J.

3. Press CHARGE. Wait until the instrument reaches full charge.
4. Simultaneously press both paddle discharge pushbuttons to transfer the energy into the test load. Confirm that **TEST 200 JOULES DELIVERED** displays on the CRT and annotates on the recorder.

PIP–Sync/Sync Annotation

1. Press LEAD SELECT to set the instrument to **PADDLES** (external **STD**).
2. Press SYNC and check that **FOR SYNC: USE LEADS** message flashes five times on the CRT and three tones sound.
3. Press LEAD SELECT to set the instrument to **LEAD II**. Set the ECG simulator for a 60bpm–NSR signal.
4. Press SYNC. Confirm that **SYNC MODE** displays on the CRT, the sync marker is clearly visible on each displayed R-wave, and the SYNC LED flashes. Confirm that the warning message does not display and no tone sounds.
5. Press RECORD. Confirm that the annotated data includes **SYNC** and a sync marker is clearly visible on the recorded ECG trace.
6. Place the paddles in the paddle storage area of the instrument. Press ▼ **ENERGY SELECT** ▲ if necessary to set the energy level to 200J.
7. Press CHARGE. Wait until the instrument reaches full charge. Simultaneously press both paddle discharge pushbuttons to transfer the energy into the test load.
8. Check that the recorder annotates **SYNC TEST 200 JOULES DELIVERED.**
9. Confirm that the **SYNC MODE** display and LED are off, and no sync markers are visible.

PIP–Recorder/CRT Noise

1. Short the RA and LL leads of the patient cable together.
2. Set the ECG gain to **X4.0**. Select **LEAD II**.
3. Press RECORD to start the recorder.
4. Confirm that the CRT and recorder baseline noise is less than 3mm p–p (2mm if in **MON** mode).
5. Select **PADDLES**. Short the paddles and confirm that the CRT and recorder baseline noise is less than 3mm p–p.
6. Return the paddles to the paddle storage area.

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PIP–Defib Disarm

1. Press ▼ ENERGY SELECT ▲ and set the energy level to 0J.
2. Press the CHARGE pushbutton.
3. Confirm that the CHARGE LED does not light and that the CRT continues to display **0 JOULES SELECTED.**

PIP–Paddle Polarity

Paddle polarity confirms a positive-going QRS waveform.

Warning

SHOCK HAZARD. Always discharge the defibrillator by doing the Defib Disarm test before the Paddle Polarity test. Testing paddle polarity with a charged instrument could result in personal injury.

1. Remove the paddles from the paddle storage area.
2. Set the ECG gain to **X1.0.**
3. Place the paddles back-to-back with the electrodes out, pressing the left wrist against the APEX electrode and the right wrist against the STERNUM electrode.

Note: Placing the paddles on the wrists will produce a more defined waveform, but polarity may be difficult to determine on some people. If so, be aware that the QRS waveform may appear negative–going.

4. Check that a positive–going QRS waveform displays on the CRT.
5. Return the paddles in the paddle storage area.

PIP–Charge Time

1. Press ▼ ENERGY SELECT ▲ to set the energy level to 360J. Place the paddles in the paddle storage area.
2. Simultaneously press CHARGE and start the stopwatch. Stop the watch when the instrument reaches full charge. Check that the charge time is less than 10s.
3. Simultaneously press paddle discharge pushbuttons to transfer the energy into the test load. Check that **TEST USE 200 JOULES** displays on the CRT and three tones sound.

PIP–Discharge Control/Open Air Discharge

Open air discharges must be performed by service personnel familiar with this instrument.

Warning

SHOCK HAZARD. During open air discharges, potentially lethal voltages are present on the paddle electrodes. Hold paddles away from the body.

1. Press ▼ ENERGY SELECT ▲ to set the energy level to 360J. Press CHARGE.
2. Hold the paddles at least one foot apart and away from the body.
3. Shake the paddles and check that no discharge occurs.
4. Press the APEX discharge pushbutton and check that no discharge occurs.
5. Press the STERNUM discharge pushbutton and check that no discharge occurs.
6. Simultaneously press both discharge pushbuttons. Check that discharge occurs and the instrument continues normal operation.

PIP–Energy Dump

1. Connect the paddles to the energy meter electrodes.
2. Press ▲ ENERGY SELECT ▼ and set the energy level to 360J.
3. Press CHARGE.
4. After the instrument charges to 360J, change the energy level to 300J.
5. Confirm that **CHARGE REMOVED** appears for 4s to 6s and three tones sound.

PIP–Charge Reduction

1. Connect the paddles to the energy meter electrodes.
2. Press ▲ ENERGY SELECT ▼ and set the energy level to 360J. Press CHARGE.
3. When full charge is reached, immediately change the energy level to 1J and press CHARGE.
4. Confirm that full charge is reached in 20s or less after CHARGE is pressed.

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PIP–Delivered Energy

Connect the paddles to the energy meter electrodes. Refer to Table 3–1 and confirm that the delivered energy is within tolerances for each energy level.

Table 3–1 Delivered Energy Tolerances

Energy Setting	Tolerance	Energy Setting	Tolerance
1J	±0.2J	10J	±1J
2J	±0.2J	20J	±2J
3J	±0.3J	30J	±3J
4J	±0.4J	50J	±5J
5J	±0.5J	100J	±10J
6J	±0.6J	200J	±20J
7J	±0.7J	300J	±30J
8J	±0.8J	360J	±36J
9J	±0.9J		

PIP–CODE SUMMARY

1. Press ON twice to switch instrument power off then on.
2. Place the paddles on the energy meter electrodes. Press LEAD SELECT to set the instrument to **LEAD II**.
3. Connect the ECG simulator to the patient cable and set for a 60bpm–NSR signal.
4. Press SYNC.
5. Press ▲ ENERGY SELECT ▼ and set the energy level to 200J.
6. Press CHARGE. When full charge is reached, simultaneously press both paddle discharge pushbuttons to transfer the energy into the energy meter.
7. Press RECORD twice to switch recorder on, then off quickly.
8. Press CODE SUMMARY.
9. Check that the recorded data matches the data shown in Figure 3–3. (The date, elapsed time, and ECG data of Figure 3–3 is representative of the actual data printed in the test sample.)

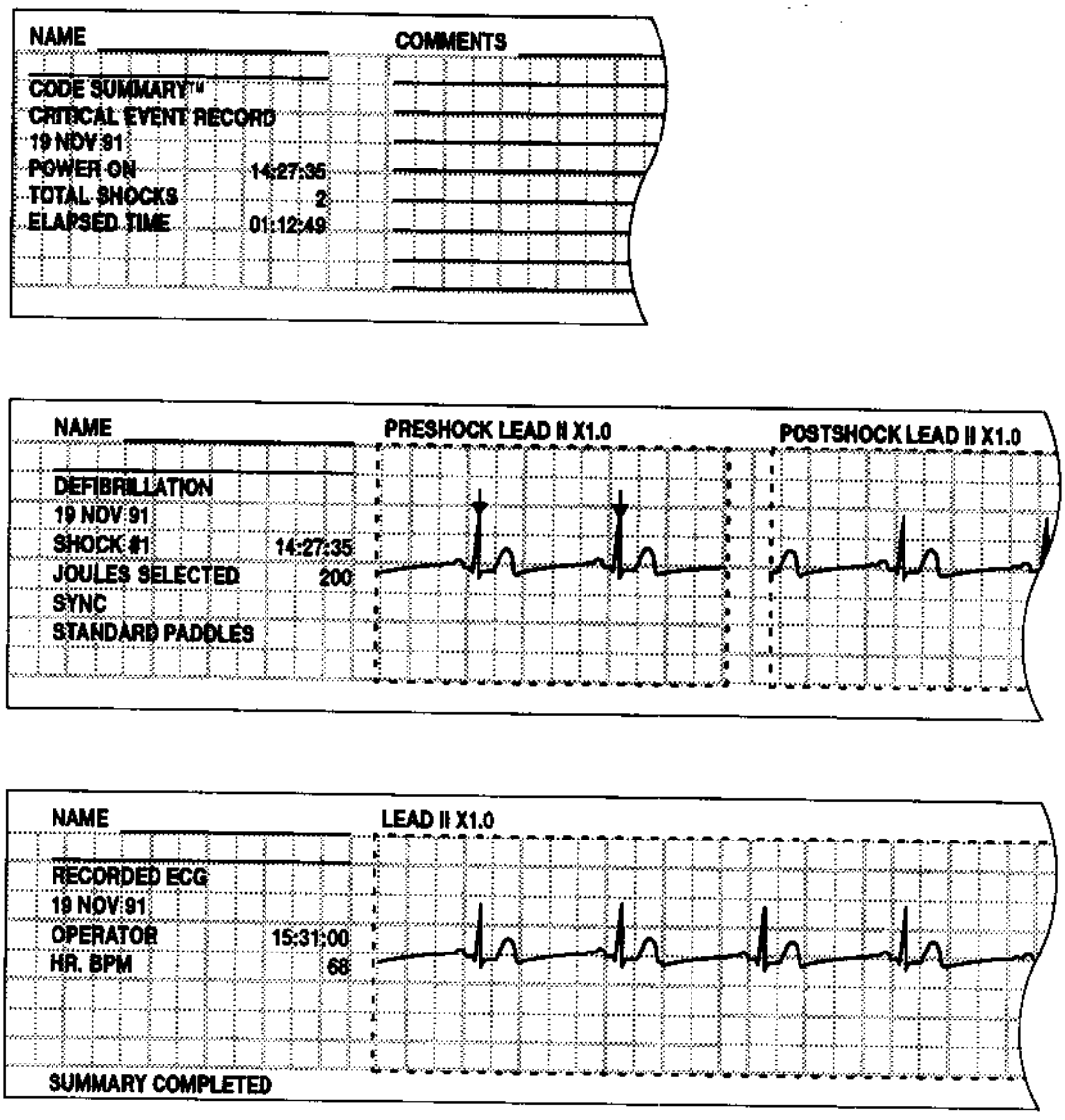

Figure 3–3 CODE SUMMARY Printout

PIP-Leakage

Check ac leakage in accordance with AAMI/ANSI standard ES1 F/1985. For 220V operation consult local guidelines.

- Lead Source/ Sink Current: 20μA or less
- Paddles: 100μA per paddle or less (typically 55μA)
- Chassis Leakage: less than 100μA (typically less than 40μA)
- Ground Resistance: 0.15Ω or less

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PIP Checklist

Name: _____
Location: _____
Date: _____

Warning

SHOCK HAZARD. The defibrillator stores and delivers potentially hazardous voltages. Test and service personnel must be familiar with this instrument before performing these procedures.

PIP–Physical Inspection	____	External case, controls, power cord, cables in good condition
PIP–Battery Charge Legend	____	**BATT CHRG** legend illuminates when ac power connected
PIP–AC Power	____	ON LED illuminates after pressing ON
	____	**©1989, PCC** displays for at least 5s within 10s
	____	**LEAD II, X1.0, 200 JOULES SELECTED** displays
PIP–Battery Power	____	Instrument stays on (**BATT CHRG** off) after disconnecting ac
PIP–Keypad Test	____	No beep sounds when APEX discharge pushbutton is pressed
	____	No beep sounds when STERNUM discharge pushbutton is pressed
	____	Beep sounds when APEX and STERNUM discharge pushbuttons are pressed simultaneously
	____	**KEYPAD: OK** displays
PIP–Lead Select	____	All lead configurations display in reverse video (**LEAD II, LEAD III, STD, PADDLES, LEAD I**)
	____	ECG signal displays on CRT in all lead configurations
PIP–Recorder Speed/ Baseline Centering	____	Distance between consecutive ECG peaks is 25mm ±1mm
	____	Baseline centered within ±1.5mm
PIP–ECG Display	____	CRT flatline is level and centered end to end, messages are visible
PIP–1mV CAL	____	10mm ±0.5mm calibration pulse with less than 0.5mm overshoot
PIP–CRT Gain/Aspect Ratio	____	CRT signal amplitude is 3.4cm ±0.2cm p–p
	____	Recorded signal amplitude is 2.0cm ±0.1cm

PIP–Heart Rate

____ Systole indicator flashes, heart rate = 30bpm ±3bpm
____ Systole indicator flashes, heart rate = 60bpm ±3bpm
____ Systole indicator flashes, heart rate = 240bpm ±7bpm

PIP–Rate Alarms/ Alarm–Activated Record

____ HR ALARM LED on and **150/40** displays
____ **120/60** and **160/90** displays consecutively
____ **150/40** displays in normal video
____ With ECG simulator set to 160bpm; alarm sounds, **150** flashes, and recorder runs for 16s
____ Recorded HR is 151bpm or higher
____ **160**bpm ±5bpm displays
____ Alarm stops when HR ALARM is pressed
____ With ECG simulator at 30bpm, HR ALARM pressed; alarm sounds, **40** flashes, and recorder runs
____ Alarm stops when HR ALARM is pressed

PIP–Recorder Annotation

____ Heart rate, time, and date annotate every 20s
____ Time is accurate ±1min
____ **LEAD III**, heart rate, time, and date annotate

PIP–Test Load

____ **TEST 200 JOULES DELIVERED** displays and records

PIP–Sync/Sync Annotation

____ **FOR SYNC: USE LEADS** legend flashes 5 times and, 3 tones sound
____ **SYNC MODE** displays on CRT, sync marker on trace SYNC LED flashes, no warning message displays, no tone sounds
____ SYNC and sync marker annotate on recorder
____ **SYNC TEST 200 JOULES DELIVERED** annotates on recorder
____ **SYNC MODE** display and LED are off, no sync markers visible

PIP–Recorder/CRT Noise

____ Less than 3mm p–p in all lead configurations
____ Less than 3mm p–p with paddles shorted

PIP–Defib Disarm

____ With CHARGE pressed; CHARGE LED does not light, CRT displays **0 JOULES SELECTED**

PIP–Paddle Polarity

> **Warning** **SHOCK HAZARD.** Always discharge the defibrillator by doing the Defib Disarm test before the Paddle Polarity test. Testing paddle polarity with a charged instrument could result in personal injury.

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PIP–Paddle Polarity (continued)

____ Positive QRS displays

PIP–Charge Time

____ Charge time to 360J is less than 10s

____ **TEST USE 200 JOULES** displays, three tones sound

PIP–Discharge Control/Open Air Discharge

> **Warning** **SHOCK HAZARD.** During open air discharges, potentially lethal voltages are present on the paddle electrodes. Hold paddles away from the body.

____ No discharge when paddles are shaken

____ No discharge when APEX discharge pushbutton is pressed

____ No discharge when STERNUM discharge pushbutton is pressed

____ Discharge when both discharge pushbuttons are pressed

PIP–Energy Dump

____ **CHARGE REMOVED** displays for 4s to 6s, three tones sound

PIP–Charge Reduction

____ Full charge in 20s or less

PIP–Delivered Energy

____ Confirm that selected and delivered energy levels are within tolerances.

Energy Setting	Tolerance	Energy Setting	Tolerance
_____ 1J	±0.2J	_____ 10J	±1J
_____ 2J	±0.2J	_____ 20J	±2J
_____ 3J	±0.3J	_____ 30J	±3J
_____ 4J	±0.4J	_____ 50J	±5J
_____ 5J	±0.5J	_____ 100J	±10J
_____ 6J	±0.6J	_____ 200J	±20J
_____ 7J	±0.7J	_____ 300J	±30J
_____ 8J	±0.8J	_____ 360J	±36J
_____ 9J	±0.9J		

PIP–CODE SUMMARY

____ Recorded data matches data shown

PIP–Leakage

____ Lead Source/Sink Current (≤ 20µA)

____ Paddles (≤ 100µA per paddle)

____ Chassis Leakage (< 100µA)

____ Ground Resistance (≤ 0.15Ω)

Test and Calibration (TC) Procedures

These tests check that the LIFEPAK 9 defibrillator/monitor is operating within factory specifications. Perform the PIP after completing any of these tests.

Test and calibration, repair, and component removal should be attempted only by personnel qualified by training or experience.

Warning

SHOCK HAZARD. Terminals and wires carrying high voltage are exposed with the instrument cases separated. Do not touch internal circuitry except as indicated in these procedures.

Caution

Avoid Component Damage. Special handling of PCB assemblies containing static sensitive devices (SSDs) is required. Refer to page 4–4. Static sensitive devices are indicated in Section 5 parts lists with this symbol.

TC–Servicing Guidelines

Some test and calibration procedures require opening the instrument case. Disassembly Procedures begin on page 4–4.

- Inspect the instrument for signs of damage before disassembling.
- Label each lead or draw a sketch showing the location of cables and wires before removing a PCB or mechanical assembly for repair or replacement.
- Repair procedures are discussed on page 4–12. Printed circuit boards (PCBs) that cannot be repaired in the field should be returned to Physio–Control for service.

TC–Test Equipment

Test equipment suitable for maintenance and calibration of the LIFEPAK 9 defibrillator/monitor is listed in Table 3–2. Although specific, commercially available test instruments are recommended, test equipment with equivalent specifications may be used.

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Table 3–2 Test Equipment

Nomenclature	Characteristics	Manufacturer
Digital Multimeter	Range: 0V to 1000V full scale 4.5 digit Accuracy: 0.5% of full scale on Vdc and resistance ranges, 1% of reading on Vac	Fluke 8050A
Energy Meter	Power range: 0J to 1000J Load resistance: 50Ω ±0.5% Accuracy: 2% of full scale for pulse width of 5ms	Electronics Unlimited DT 650A
Stopwatch	Accuracy: 0.25s	
Storage Oscilloscope	Bandwidth: dc to 100MHz Vertical sensitivity: 5mV/div to 50V/div Input impedance: 1MΩ/10MΩ Sweep range: 1µs/div to 1s/div	Tektronix model 2221
Function Generator	Frequency Range: 20–120 pulse position modulation	Krohn–Hite model 5400A
Photometer	To measure luminance in foot–lamberts	Tektronix J16 with J6503 luminance probe

TC–Voltage Checks

1. With the instrument off remove the front panel to access the test connector J3 on the Power Conversion PCB. See page 4–5, Front Panel Removal.

2. Connect the ground lead of the digital multimeter to pin 7 of J3. Refer to Figure 3–4.

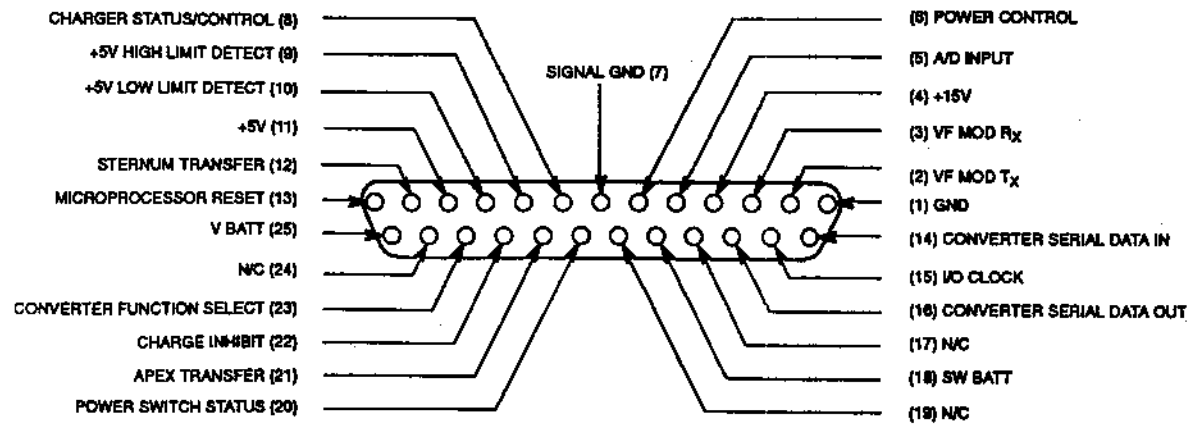

Figure 3–4 Test Connector J3 Pinout

3. Turn the instrument on and check that the voltages are within the limits listed in Table 3–3.

4. Low battery operation can be checked by measuring the thresholds in Table 3–4.

> *Note: Once illuminated, the* **LOW BATTERY: CONNECT AC POWER** *message will not reset until the battery voltage rises above 16.5V.*

Table 3–3 Power Conversion PCB Voltage Checks

Test Point	Signal Name	Nominal Voltage	Limits
Pin 4	+15V	+15.0V	±0.3V
Pin 11	+5V	+5.0V	±0.25V
Pin 9	+5V High Limit Detect	+2.25V	±0.15V
Pin 10	+5V Low Limit Detect	+2.625V	±0.125V
Pin 18	SW BATT	+18.0V	+2.0V to –2.4V
Pin 25	V BATT	+18.4V	+1.6V to –2.8V

Table 3–4 Low Battery Thresholds

Test Point	Function	Low Battery Limits	Shutdown Limits
Pin 25	Monitoring	+15.5V ±0.23V	+14.5V ±0.21V
Pin 25	Defib Charge	+15.0V ±0.22V	+13.5V ±0.20V

TC–Sync and HR Alarm LED Checks

1. Press LEAD SELECT and select **LEAD II**.

2. Press SYNC. Check that the SYNC LED illuminates and **SYNC MODE** displays.

3. Press SYNC again and check that the SYNC LED and message go off.

4. Press HR ALARM. Check that HR ALARM LED illuminates and the alarm limits display on the CRT.

5. Press HR ALARM again and check that HR ALARM LED goes off.

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TC–Defib Disarm and CHARGE LEDs check

1. With the instrument off, fasten the paddles to the energy meter electrodes.
2. Turn the instrument on. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 0J.
3. Press CHARGE. Check that the CHARGE LED does not illuminate and the CRT continues to display **0 JOULES SELECTED.**
4. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 200J.
5. Press CHARGE and check that both the front panel and APEX paddle CHARGE LEDs flash during the charge cycle.
6. Confirm that the LEDs remain on and a tone sounds when full charge is reached.
7. Simultaneously press paddle discharge pushbuttons to transfer the charge. Check that the CHARGE LEDs go off.

TC–Test Mode

The LIFEPAK 9 defibrillator/monitor contains self–test software to identify problems and calibrate the instrument. To initiate test mode:

1. With the instrument power off, press and hold LEAD SELECT and HR ALARM.
2. Press ON. Continue holding LEAD SELECT and HR ALARM until the message **SELECTED TEST:** and a list of options appears on the CRT. This is the top–level menu (Refer to Figure 3–5).

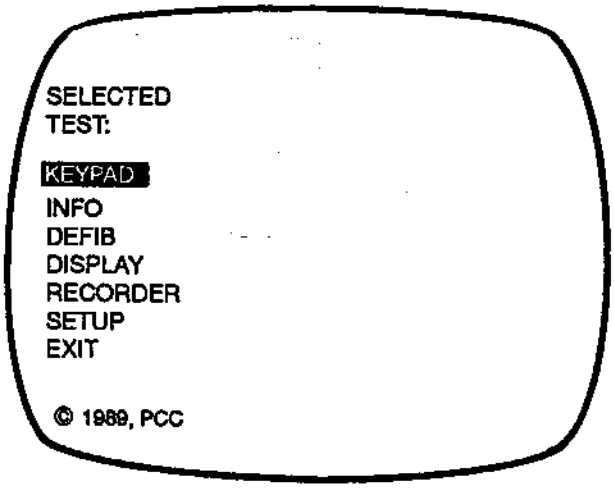

Figure 3–5 Top–Level Menu

The following front panel controls have a secondary function while the instrument is in the test mode.

LEAD SELECT: Press to interrupt test in progress and return to the top–level menu.

▼ ECG SIZE ▲: Press ▲ and ▼ to scroll through the available selections.

HR ALARM: Press to start test or to enter the selected option.

TC–Defibrillator Calibration

1. With the instrument off, fasten the paddles to the energy meter electrodes.
2. Initiate test mode (refer to page 3–18).
3. Scroll to the **DEFIB** test using ▼ ECG SIZE ▲ .
4. Press HR ALARM to start the **DEFIB** test.
5. Use ▼ ENERGY SELECT ▲ to scroll to **LOW**. Select 1J.
6. Press the CHARGE pushbutton and wait until the instrument reaches full charge.
7. Simultaneously press both paddle discharge pushbuttons to transfer the energy into the energy meter.
8. Confirm that the CRT displays the message **JOULES DELIVERED: XXX**, where XXX is the energy selected.
9. Read the value on the energy meter.
10. Use ▼ ECG SIZE ▲ to change the **JOULES DELIVERED: XXX** value until it matches the value on the energy meter.
11. Press HR ALARM to enter the adjusted value.
12. Press CHARGE and discharge the same energy level again into the energy meter. Check that the energy meter shows the selected value ±10% (±20% for 1J setting).
13. Press HR ALARM to restart the **DEFIB** test.
14. Repeat steps 5 through 13 for each energy level.

Caution

Avoid Energy Meter Damage. Start each test at the lowest energy level to avoid overheating the energy meter. Test each energy level in successive order.

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TC–Test Load Calibration

> ***Note:*** *Complete Defibrillator Calibration before calibrating the test load.*

1. Place the paddles in the paddles storage area of the instrument.
2. Turn off the instrument and initiate test mode (see page 3–18).
3. Scroll to the **DEFIB** test using ▼ ECG SIZE ▲.
4. Press HR ALARM to start the **DEFIB** test.
5. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 200J.
6. Press the CHARGE pushbutton.
7. After the instrument reaches full charge, simultaneously press the paddle discharge pushbuttons to transfer the energy into the test load.
8. When the CRT displays **JOULES DELIVERED: 200**, press HR ALARM.
9. Press LEAD SELECT to return to the top–level menu.
10. Select **EXIT** to resume normal operation. Select **STD** lead.
11. Press the CHARGE pushbutton. After the instrument reaches full charge, simultaneously press the paddle discharge pushbuttons to transfer the energy into the test load.
12. Check that the CRT displays **TEST 200 JOULES DELIVERED**.
13. Confirm that the recorder prints the time and date followed by **TEST 200 JOULES DELIVERED.**

TC–Charge Time

1. Place the paddles in the paddles storage area of the instrument.
2. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 360J.
3. Simultaneously press CHARGE and start the stopwatch.
4. Check that the charge time is less than 10s.
5. Simultaneously press the paddles discharge pushbuttons to transfer the energy into the test load.

TC–Charge Reduction

1. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 360J.
2. Press the CHARGE pushbutton.
3. After the instrument reaches full charge, quickly select 1J delivered energy.
4. Simultaneously press the CHARGE pushbutton and start the stopwatch.
5. Confirm 1J is reached in less than 20s.
6. Simultaneously press the paddles discharge pushbuttons to transfer the energy into the test load.

TC–Energy Dump

1. Connect the paddles to the energy meter electrodes.
2. Use ▼ ENERGY SELECT ▲ to set the energy level to 360J.
3. Press the CHARGE pushbutton.
4. Change the energy level to 300J. Check that **CHARGE REMOVED** flashes for 4s to 6s.

TC–Output Waveform

1. Fasten the paddles to the energy meter electrodes.

> ***Note:*** *The pulse polarity is positive with the APEX paddle on the right electrode of the energy meter.*

2. Connect the oscilloscope to the BNC connector on the energy meter.
3. Set the oscilloscope to 0.5V/div, 1ms/div, + slope, and dc trigger.

> ***Note:*** *0.5V on the oscilloscope = 10A defibrillator output.*

4. Use ▼ ENERGY SELECT ▲ to set the delivered energy to 360J.
5. Press CHARGE.
6. When the instrument reaches full charge, simultaneously press the paddle discharge pushbuttons to transfer the energy into the energy meter.

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7. Check that the waveform meets the following specifications. Refer to Figure 3–6 .

Peak current	= 45A to 65A peak
Time above 50%	= 2.10ms to 4.20ms
Time above 10%	= 3.10ms to 9.20ms

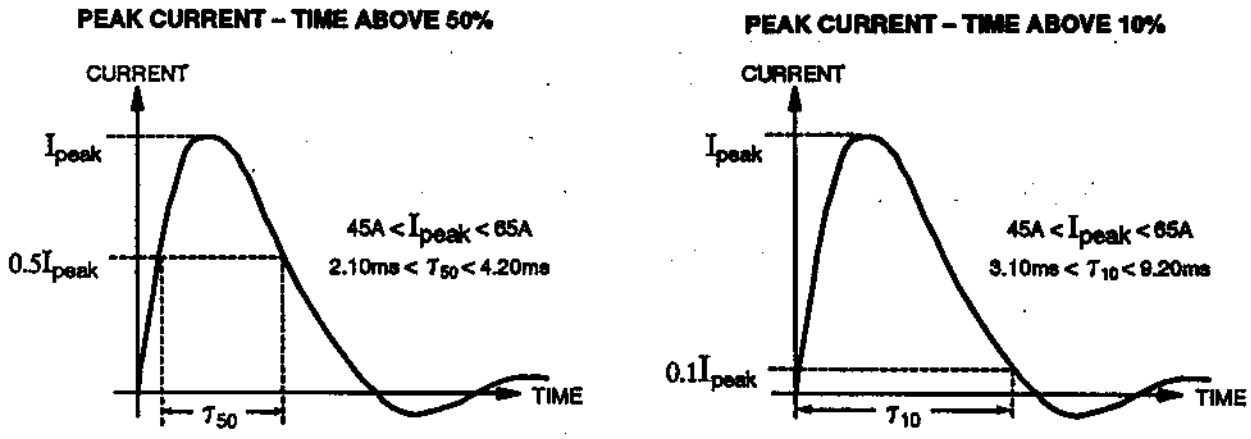

Figure 3–6 Output Waveform

TC-Display Calibration

The following paragraphs describe the calibration procedure for the Display Assembly PCB. Perform the tests in a dimly–lit room. Figure 3–7 shows the location of all Display Assembly PCB potentiometers.

1. Separate front and rear cases to adjust the potentiometers. See page 4–6, Case Separation.

Warning

SHOCK HAZARD. The Display Assembly produces high voltages. Do not make contact with the CRT anode connector or the CRT bias generator circuitry when the instrument is on.

Warning

FLYING GLASS HAZARD. The CRT is made of glass and contains a vacuum which may implode if broken. Handle with care and wear safety glasses when removing the CRT from the Display Assembly PCB.

Warning **SHOCK HAZARD.** Dangerous voltages are present on the pins of R302 and R306. Use an insulated screwdriver for adjustment.

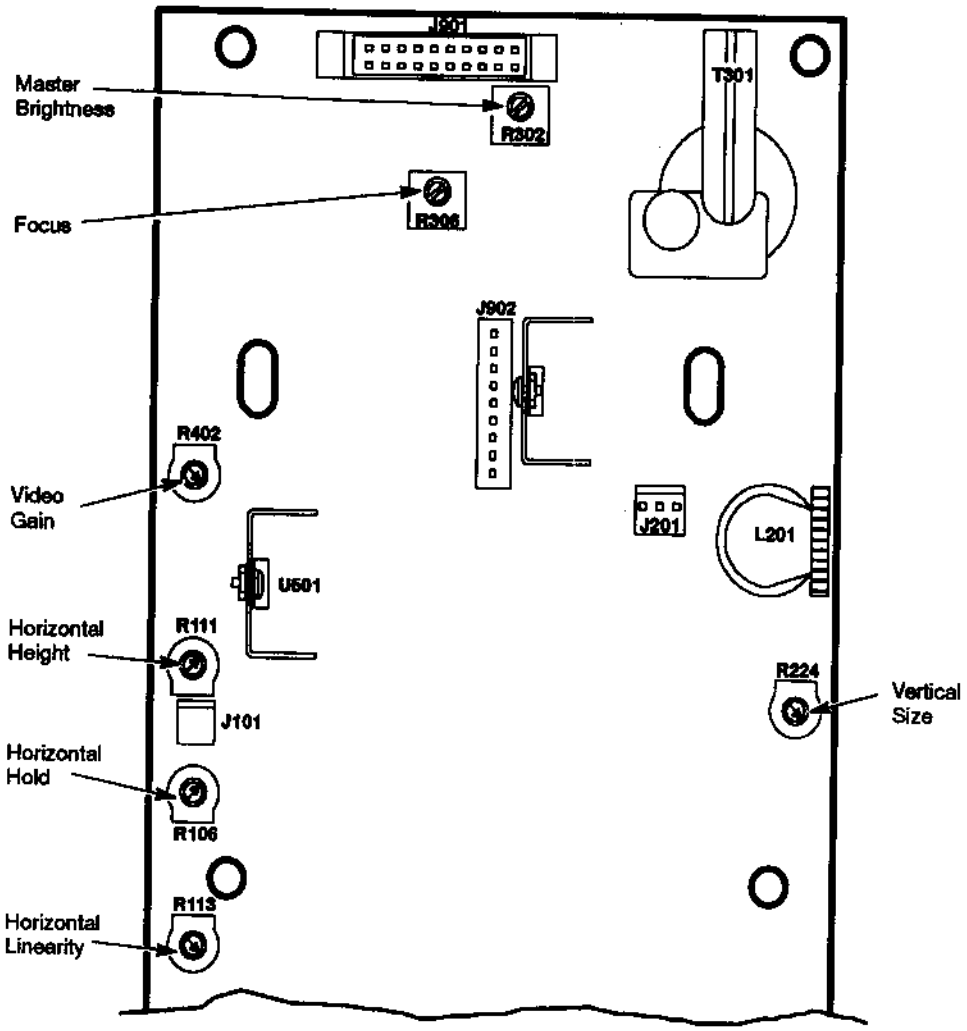

Figure 3–7 Display Assembly PCB Potentiometer Locations

2. Reconnect ac input cord. Reconnect J1 on the front panel.

Note: *Reroute J1 ribbon cable underneath C32 on the Power Conversion PCB to prevent strain on the capacitor during the following tests.*

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3. Press ON. Adjust R302, Master Brightness, until the vertical raster lines are visible behind the characters.
4. Adjust R106, Horizontal Hold, approximately 1/8 turn past the point where the horizontal rolling stops.
5. Turn the instrument off, then initiate test mode (see page 3–18) and select **DISPLAY**.
6. Use **HR ALARM** to start the **DISPLAY** test.
7. Select the **PATTERN** test using **▼ ECG SIZE ▲**.
8. Adjust: R224, Vertical Size; L201; and R111, Horizontal Height, to obtain a display pattern that fills most of the screen.
9. Loosen the screw holding the yoke clamp.
10. Rotate the yoke until the display pattern is level.
11. Tighten the screw and check that the display pattern is still level.
12. Adjust the yoke rings to center the display pattern on the CRT.
13. Adjust R224, Vertical Size, for a display pattern grid height of 73.7mm ±2.5mm. Adjust L201 to make each box of the display pattern the same height.

> *Note: The adjustments of R224 and L201 are interactive. Repeat the preceding step until both measurements are correct.*

14. Adjust R402, Video Gain, fully counterclockwise.
15. Turn the instrument off and allow the CRT to cool down for approximately 10min. Initiate test mode and select the **DISPLAY** pattern test.

Warning

SHOCK HAZARD. Potentially dangerous voltages are present on the pins of R302 and R306. Use an insulated screwdriver for adjustment.

16. Adjust R302, Master Brightness (background), counterclockwise just until the raster disappears. Adjust R302 counterclockwise approximately 1/16 turn more. Turn the instrument off.

17. Initiate test mode and select the **DISPLAY** pattern test. Turn R402, Video Gain, clockwise until the normal display intensity is visible.

> ***Note:*** *Raster will not reach normal intensity if R302 is turned too far counterclockwise.*

18. Adjust R111, Horizontal Height, for an overall pattern width of 106.7mm ±2.5mm. Adjust R113, Horizontal Linearity, so that each box is the same width.

> ***Note:*** *The adjustments of R111 and R113 are interactive. Repeat the above step until both measurements are correct.*

19. Adjust R402, Video Gain, for a dim display. Adjust R306, Focus, for maximum sharpness of the display characters.

20. Adjust the yoke rings to center the test pattern on the CRT within 2.5mm. Using a piece of recorder paper, confirm that the difference in height of the right side to the left side of the test pattern is less than or equal to 1.5mm. Check that the difference in width from the top to the bottom is less than or equal to 2.1mm.

21. Adjust R402, Video Gain, clockwise until the normal display intensity is visible.

> ***Note:*** *When the case is installed, magnetic interference from the Power Supply PCB may offset the display horizontally. Return to display mode and rotate yoke rings to center display.*

TC-Power Supply Calibration

1. Separate front and rear cases to reach R23. See page 4–6, Case Separation. Reconnect the battery to the instrument.

> ***Note:*** *The Power Supply compensates for temperature fluctuations. The instrument must be powered–on for at least 30min prior to calibration so the temperature around thermistor RT2 stabilizes.*

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2. Connect the digital multimeter between the positive and negative battery terminals.

3. Connect the ac power cord and press ON. Adjust R23 for +18.4V ±1%.

TC–Recorder Calibration

1. Initiate test mode (see page 3–18).

2. Select the **RECORDER** test.

3. Select the **PATTERN** test.

> ***Note:*** *During this calibration procedure the printhead dot intensity is decreased to prevent damage to the printhead and drive roller. Consequently, print legibility may range from light to invisible.*

4. Rotate R176, Paper Out Sense, on the Main PCB, fully clockwise. See Figure 3–8 for potentiometer locations.

5. Place a roll of paper in the Strip Chart Recorder.

6. Press RECORD. Check that the recorder does not run.

7. Rotate R176 counterclockwise while pressing RECORD. Adjust R176 just to the point where the recorder turns on and stays on. Note the position of the potentiometer. This procedure may need to be repeated to determine the turn–on threshold.

8. Remove the paper from the recorder. Close the recorder doors.

9. Rotate R176 counterclockwise while pressing RECORD. Adjust R176 just to the point where the recorder turns on and stays on. Note the position of the potentiometer.

10. Adjust R176 to midpoint between the positions noted in steps 7 and 9.

11. Confirm that the recorder only runs when paper is loaded.

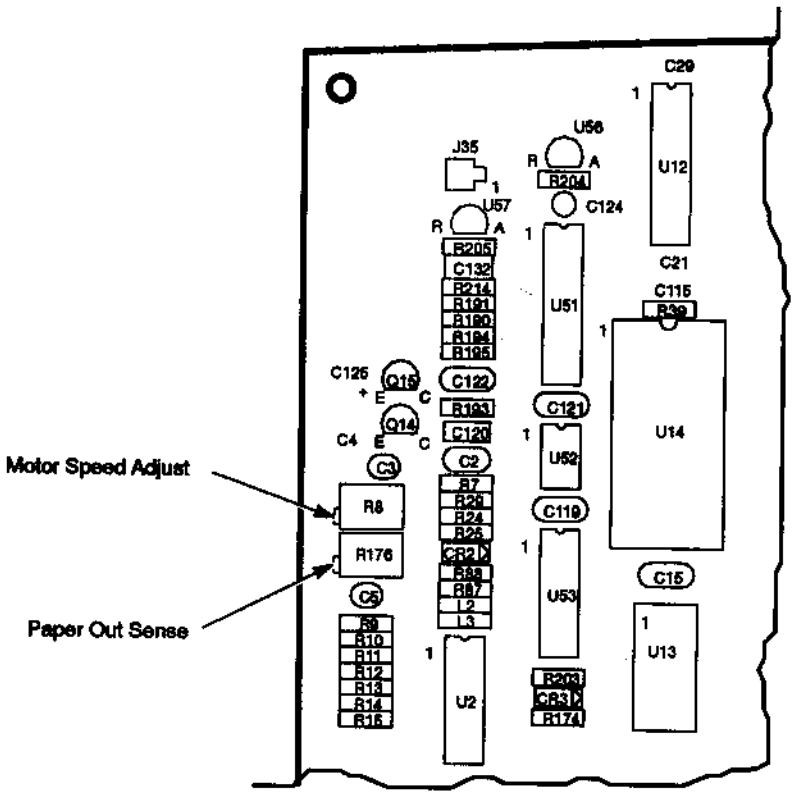

Figure 3–8 Main PCB Recorder Calibration

12. Select the **MOTOR SPEED** test.

13. Press RECORD. Check that the recorder produces a test pattern of bars that align with the paper grid when the motor speed is correctly adjusted. The bars may create a pattern of light and dark areas. Adjust R8, Motor Speed Adjust, on the Main PCB until these light and dark areas disappear.

14. Confirm that the period of the recorder sawtooth waveform is 25mm ±1mm. Adjust R8 if necessary.

TC–Recorder Frequency Response

1. Turn off the instrument. Initiate test mode (see page 3–18).

2. Select **SETUP** and then **RECORDER**. Select the **DIAG** option. Press HR ALARM to enter option change.

3. Press LEAD SELECT to return to the top–level menu and select **EXIT** to resume normal operation.

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4. Press LEAD SELECT to set the instrument to **LEAD II**. Press ▼ ECG SIZE ▲ for **X1.0 gain.**

5. Connect the function generator to the patient cable input using the test signal setup shown in Figure 3–9.

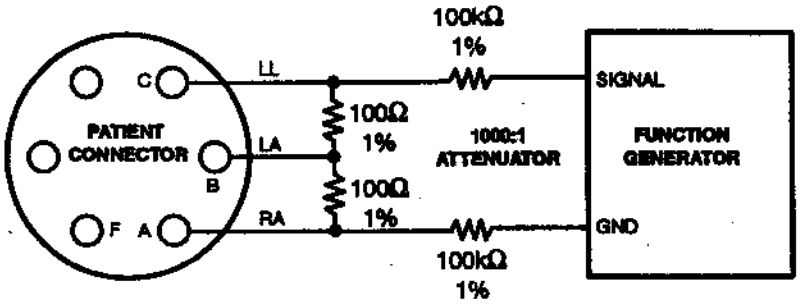

Figure 3–9 Test Signal Setup

6. Set the function generator for a 1V, 10Hz sinewave. Press the RECORD pushbutton to start the recorder.

7. Sweep the function generator from 0.05Hz to 0.5Hz and check that the recorded trace is between 7mm p–p and 10.5mm p–p.

8. Sweep the function generator from 0.5Hz to 60Hz and check that the recorded trace is between 9mm p–p and 10.5mm p–p.

9. Sweep the function generator from 60Hz to 100Hz and check that the recorded trace is between 7mm p–p and 10.5mm p–p.

10. Increase the frequency to 110Hz and check that the recorded trace is less than 7mm p–p.

11. Turn the instrument off then initiate test mode. Select **SETUP** and switch the **LEADS NOTCH** to **YES.** Press HR ALARM to enter the option change. Exit test mode.

12. Set the instrument to **LEAD II.** Set the function generator sinewave to 1V and match the input line frequency (50Hz or 60Hz).

13. Press RECORD. Check that the recorded trace is less than 1mm p–p.

14. Turn off the instrument then initiate test mode. Select **SETUP** and switch the **RECORDER** option to **MON.** Switch **LEADS NOTCH** to **NO.** Press HR ALARM to enter the option change. Exit test mode.

15. Set the function generator for a 1V, 10Hz sinewave.
16. Press LEAD SELECT to set the instrument to **LEAD II**. Press ▼ ECG SIZE ▲ to set the gain to **X1.0**.
17. Press RECORD. Sweep the function generator from 1Hz to 40Hz and confirm the recorded trace is 7mm p–p minimum.

TC–CRT Frequency Response

1. Press ▼ ECG SIZE ▲ to increase the ECG gain to **X1.4**.
2. Connect the function generator to the patient cable using the test signal setup shown in Figure 3–9, page 3–28.
3. Set the function generator for a 1V, 10Hz sinewave.
4. Decrease the frequency to 1Hz. Confirm that the trace displayed on the CRT is 1.9cm p–p ±0.2cm.
5. Increase the frequency to 40Hz. Confirm that the trace displayed on the CRT is 1.9cm p–p ±0.2cm.
6. Disconnect the function generator.

TC–ECG Output (when applicable)

1. Use LEAD SELECT to select **LEAD II**.
2. Connect the function generator to the patient cable. Input 1mV, 10Hz sinewave.
3. Connect a 1/4in phone plug to ECG output (on the rear panel of the instrument) and the oscilloscope to the phone plug.
4. Use ▼ ECG SIZE ▲ to set the gain to **X1.0**.
5. Check that a 1Vp–p ±0.15Vp–p sinewave shows on the oscilloscope.

Error Codes

The LIFEPAK 9 defibrillator/monitor contains self–diagnostic software. When a failure is detected during the self–test, the **SERVICE** legend illuminates. For many failures, an error code is generated and displayed in the **INFO** menu.

To access the **INFO** menu, initiate test mode (see page 3–18). Use ▼ ECG SIZE ▲ and select INFO. The error code is listed after **FAULT STATUS**.

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Refer to Table 3–5 for the software or circuit failure associated with each error code.

Table 3–5 Error Codes

Error Code	Software or Circuit Failure
1	Watchdog hardware failure (fast test)
2	Watchdog hardware failure (slow test)
3	Unknown transfer code
4	Unknown watchdog code
5	Recorder motor stalled/paper jam
6	SAS Adapter fault
7	System RAM test failure (U28)
8	System microprocessor RAM failure (U30)
9	System controller ROM failure (U27)
10	Critical ROM failure (U27)
11	Display interface RAM failure (U13)
12	Display/recorder microprocessor RAM failure (U1)
13	Display interface ROM failure (U14)
14	D/A converter CRC failure
15	Transfer switching failure (Q4,CR4)
16	Transfer enable stuck on
17	Charge reference out of tolerance
18	Preamp baseline out of tolerance
19	Clock failure
20	+5V supply out of tolerance
21	+15V supply out of tolerance
22	Defib cal factors out of tolerance
23	A/D converter (U9) self–test failure
24	Recorder printhead resistance out of tolerance

Service and Maintenance 4

Introduction

This section provides the following information:

- Battery Maintenance
- General Maintenance
- Disassembly Procedures
- Inspection Techniques
- Tools and Materials for Cleaning and Repair
- Cleaning Procedures
- Printed Circuit Repair Techniques
- Shipping Assembly.

Before servicing or repairing the instrument: become familiar with the information in this section; examine the instrument (see Inspection Techniques beginning on page 4–9); identify components, assemblies, and wire and cable harnesses using Section 5.

Battery Maintenance

The LIFEPAK 9 defibrillator/monitor contains sealed lead-acid batteries. The life expectancy of lead-acid batteries depends primarily on temperature and use. They generally last two years.

Warning

POTENTIAL BATTERY DEPLETION DURING MONITORING.
Use ac power for long-term patient monitoring. Using battery power for long-term monitoring decreases the stored battery charge and the available defibrillator discharges until the battery is recharged.

Batteries perform best when kept fully charged (charged for at least 24hrs). The batteries provide useful (not 100%) operating time after three hours of charging, but they should not be used in this manner on a routine basis.

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Warning **POTENTIAL INSTRUMENT SHUTDOWN.** When the **LOW BATTERY: CONNECT AC POWER** message appears, connect the instrument to ac power for continuous operation and to recharge the battery. The message indicates that the battery is approaching full discharge and the instrument will soon shutdown.

Caution **Potential Battery Depletion.** Do not routinely operate the instrument after **LOW BATTERY: CONNECT AC POWER** displays. This discharges the battery to its reserve capacity and shortens battery life. Connect the instrument to ac power whenever possible to keep battery charged.

Recharging Batteries

The internal batteries will continually charge when the instrument is connected to an ac power source, even with power off. Charge the batteries and operate the instrument at normal room temperature (25°C, 77°F) for optimum battery performance. Ambient temperatures greater than 40°C (129°F) may adversely affect battery life.

When not in use or during long periods of storage, connect the LIFEPAK 9 defibrillator/monitor to ac power. If this is not possible, fully charge the batteries before storage and again before use. Store at ambient room temperature.

Recycling Batteries

In the United States, recycle battery packs locally according to national, state, and local regulations when batteries are no longer useful. If local recycling is not possible, contact Physio-Control customer service specialists at 1–800–442–1142 for information on returning battery packs.

Outside the United States, recycle battery packs according to local regulations, if possible. Otherwise, contact the local Physio-Control representative for information on returning battery packs.

Use the battery recycling shipping container listed in Table 5–4, page 5–5.

Note: *Battery packs manufactured after July, 1991 are labeled with recycle symbol.*

General Maintenance

The following paragraphs contain routine maintenance procedures that can be performed either by an experienced operator or a technician.

Power Source, AC or DC Operation

To operate on ac-line power, plug the ac power cord of the instrument into a three-pin grounded ac power source. Do not use a free-ground adapter. The instrument operates on ac power whenever it is plugged in as described and the ON LED is illuminated.

To operate the instrument on the internal dc battery source, disconnect the ac power cord from the ac power source. Press ON. When the instrument is connected to a proper ac power source, even with the ON pushbutton off, the internal batteries continually charge.

Strip Chart Recorder

Maintenance on the Strip Chart Recorder consists of loading paper and cleaning. Parenthetical numbers refer to parts shown in Figure 5–11, page 5–64.

The message **NO PAPER** will appear when the recorder paper runs out.

Caution

Prevent Printhead Damage. Use only Physio-Control printer paper (PN804700) Do not run the recorder without paper. Do not use waxed paper as this can damage the printhead.

Loading Paper

1. Pull the latch (14) up and remove the empty paper spool.
2. Insert the new paper roll with the grid facing toward the front. Pull up a 2-inch length of paper.
3. Push the door (7) forward and the latch down until it latches.

Cleaning

Clean the printhead and paper-out sensor periodically to remove paper dust and debris. At a minimum, clean after every 100 rolls of use. Perform these steps for cleaning:

1. Pull up the latch (14) and remove the paper roll.
2. Gently wipe the surface of the printhead and paper sensor with a cotton swab soaked in isopropyl alcohol. When cleaning the printhead, touch the printhead *only with the cotton swab,* not with your fingers.

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Protecting Printouts

Protect thermal paper printouts by following these guidelines:

- Do not apply tape or other adhesives over annotations or tracings on the front side of the paper. Apply adhesives only to the *back* of the paper.
- Do not store printouts in plastic folders. Store printouts in *paper* folders.
- Avoid extended exposure to sunlight, temperatures above 27°C (81°F), or humidity above 70 percent.

Fuse Replacement

The fuses are located in the rear panel of the instrument.

1. Place a thin, flat-blade screwdriver in the recessed area under the retaining tab of the fuse holder. Twist the screwdriver to release the retaining tab.
2. Pull the fuse holder out. Replace fuses with the same type, voltage rating, and current rating. Refer to the parts list (pg. 5–9, item 16).

Disassembly Procedures

These steps are a logical sequence for disassembling the major assemblies of LIFEPAK 9 defibrillator/monitor. Separate or disassemble only to the extent required. Parenthetical numbers refer to item numbers in the final assembly parts list (beginning on page 5–6), and Figure 5–1 (pg. 5–13). Figure 4–2 (pg. 4–7) shows "J" connector locations. Assembly procedures are the reverse unless otherwise noted.

Warning

SHOCK HAZARD. Disconnect the ac power cord and remove the battery pack before disassembly.

Caution

Potential Component Damage. This instrument contains static sensitive devices (SSDs). Use the following special handling procedures for SSDs. SSDs are indicated in Section 5 with this symbol:

Special Handling for Static Sensitive Devices

Static discharge damages semiconductor devices such as MOS ICs, FETs, optical isolators, and film resistors. Static charges build up on the body and transfer to an object when touched. This discharge can damage or destroy static sensitive devices (SSDs) without the handlers knowledge. To prevent damage when working with the instrument open, note the following:

- SSDs are identified in the Section 5 parts list with this symbol:
- Wear a conductive wrist strap attached to a static dissipating mat that is connected to earth ground.
- Keep static-generating products such as styrofoam cups or trays away from the work area.
- Transport PCBs inside labeled conductive bags.
- Label static SSDs before storing.

Battery Pack Removal

1. Open and remove the battery door (13) at the bottom of the instrument (Figure 5–1).
2. Remove the battery pack (2).
3. Free the battery pack by pressing the locking tab on the battery harness and separating the two connectors.

Front Panel Removal

1. Press in on the right edge of the front panel (A6) as shown in Figure 4–1 (arrow A).
2. While pressing the edge, push out (arrow B) until the right edge of the front panel releases.
3. Slide the front panel to the right slightly (arrow C) until the left tab clears the front case (5).
4. Place fingers under the released edge and pull the front panel away from the instrument (arrow D).
5. Press the quick-release levers and disconnect J20 from the front panel.

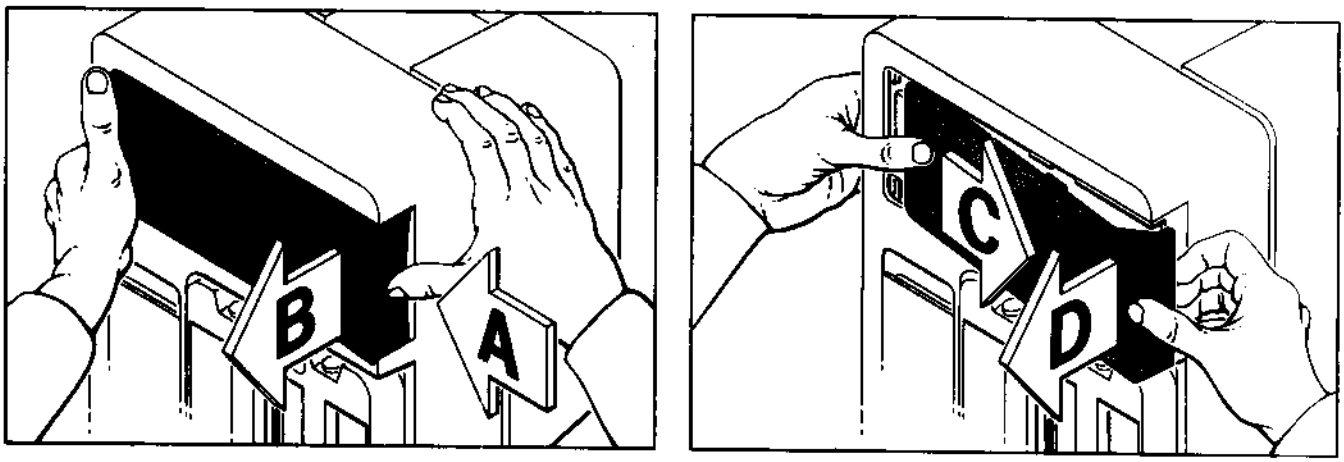

Figure 4–1 Front Panel Removal

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Strip Chart Recorder Removal

1. Pull the upper edge of the top door to open the recorder (A8). See Figure 5–1.
2. Remove the paper roll.
3. Push down the paper carrier and remove the two screws (40) at the rear of the paper housing.
4. Grasp the recorder at the bottom then pull down and away from the instrument.

Case Separation

1. Remove the battery pack, front panel, and strip chart recorder.
2. Turn the paddles connector counterclockwise then pull to disconnect. Remove the paddles.
3. Remove three screws (40) from the bottom of the instrument, four screws (40) from the rear panel (31), and two screws (40) from the handle (see Figure 5–1).
4. Pull the front case (5) forward and disconnect J36 (see Figure 4–2, page 4–7) located on the Interconnect PCB.
5. Pull the chassis away from the rear case (6).

Power Conversion PCB Removal

Complete Case Separation.

1. Disconnect J17 and J18 (see Figure 4–2, page 4–7), located on the Power Conversion PCB (A3).
2. Push the Interconnect PCB (A5) locking tabs up to clear the notches in the Power Conversion PCB.
3. Pull the Power Conversion PCB away from the Interconnect PCB to disconnect J14 and lift the Power Conversion PCB out of the board guide.
4. Disconnect J10 through J13, then J15 and J16.
5. Remove four screws (40) from the rear panel (31) and free the rear panel from the chassis (7). See Figure 5–1.
6. Disconnect J32 (wire labeled 2, goes to wave shaping inductor) and J9 (wire labeled 1 goes to Transfer Relay, A9).

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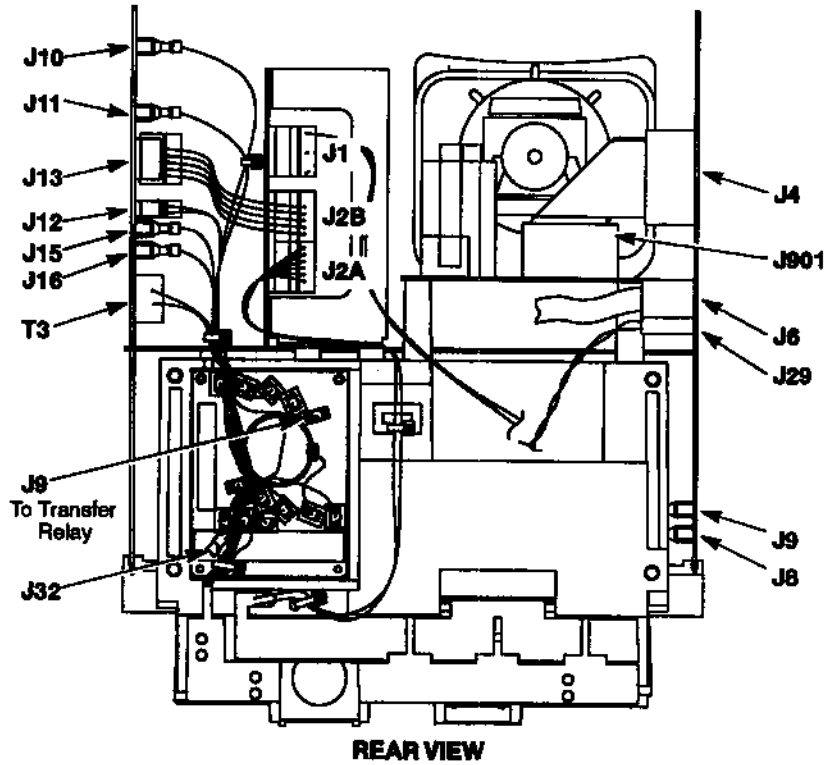
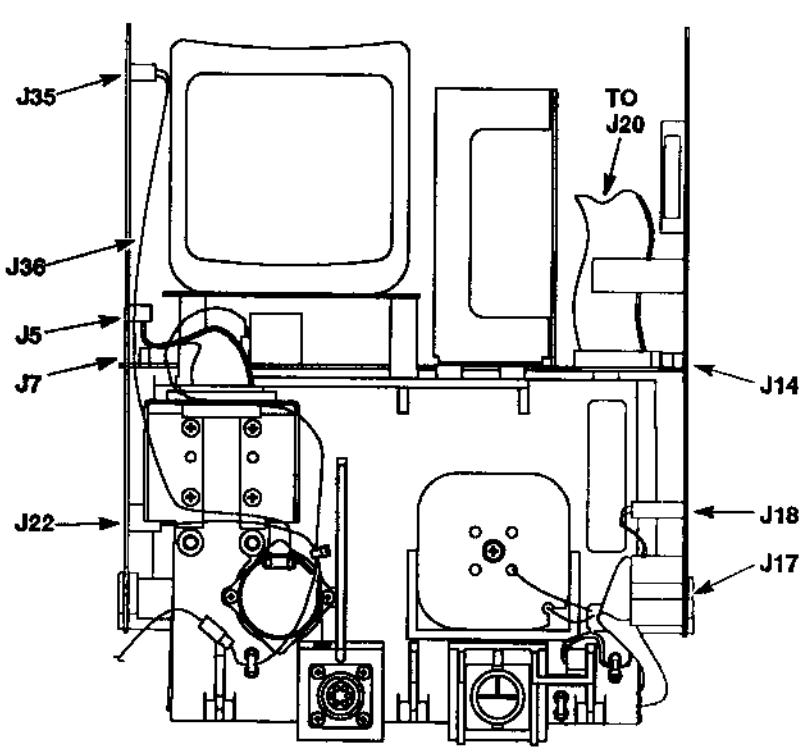


REAR VIEW



FRONT VIEW

Figure 4–2 Connector Locations

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Main PCB Removal

Complete Case Separation.

1. Press down the quick-release levers and disconnect J4 and J5 (refer to Figure 4–2, page 4–7).
2. Disconnect J6, J29, and J22 on the Main PCB (A1).
3. Push the Interconnect PCB (A5) locking tabs up off of the notches in the Main PCB.
4. Pull the Main PCB away from the Interconnect PCB to disconnect P7 and lift the Main PCB out of the board guide.
5. Disconnect J8 and J9.

Display Assembly Removal

Complete Case Separation.

1. Press down the quick-release levers and disconnect J901 (refer to Figure 4–2, page 4–7) on the Display Assembly (A4).
2. Remove four screws (40) to remove the Display Assembly (see Figure 5–1).

Power Supply Removal

Complete Case Separation .

1. Disconnect J1 (see Figure 4–2, page 4–7) on the Power Supply PCB (A2).
2. Remove four screws (40) from the rear panel (31) and remove the rear panel (see Figure 5–1).
3. Disconnect J2(A and B) on the Power Supply.
4. Remove four screws (40) from the Power Supply and detach from chassis (7).

Interconnect PCB Removal

Complete Case Separation.

1. Remove the Power Conversion PCB, the Main PCB, the Display Assembly, and the Power Supply PCB.
2. Remove four screws (40) from the Interconnect PCB (see Figure 5–1).

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Inspection Techniques

When servicing or repairing the instrument, routinely begin with a visual inspection of the hardware and components for signs of damage. Signs of damage require further inspection of the surrounding area for peripheral breakage or damage.

Exterior Inspection

Visually inspect the entire instrument for wear, corrosion, deterioration, and damage resulting from extreme temperatures or dropping. Lift and hold the instrument upside down while listening for loose hardware.

Interior Inspection

Table 4–1, Inspection Techniques, lists the major hardware components of the instrument, possible problems associated with each item, and recommended corrective actions.

Table 4–1 Inspection Techniques

Hardware	Problem	Corrective Action
Chassis, covers, and brackets	Warped, bent, damaged surfaces, or missing hardware	Replace
Components (mechanical and electrical)	Loose mountings	Repair
	Broken or damaged leads	Replace
	Deterioration or leakage	Replace
Connector pins	Bent	Straighten (if slight)
	Loose or corroded	Replace
Nameplate, labels, and decals	Not legible	Replace
PCB surfaces	Charred, cracked, or brittle	Replace PCB
	Note: Due to high operating temperatures of certain components, the PCB surface may show some degree of discoloration.	
Screws and nuts	Loose or cross-threaded	Tighten or replace
Terminals and connections	Installed incorrectly	Install correctly
	Lost or worn	Replace
	Failed solder connections	Resolder (if not damaged) or replace
Wire insulation and tubing	Deteriorated, worn, pinched, or damaged	Replace

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Tools and Materials for Cleaning and Repair

Table 4–2 lists recommended tools, materials, and chemicals required for cleaning and repair activities. Although specific items are recommended, tools and materials with specifications equivalent to those listed may be used.

Table 4–2 Tools and Materials for Cleaning and Repair

Product	Description
Static-protected work area Electronic Supply Dealers	Grounded conductive surface and wrist strap
X–32B and Xersin® 2005 solder Multicore Westbury, NY 11590	Low flux, no cleaning necessary (Refer to PCB Component Replacement, page 4–13 for correct solder choice.)
5-Minute® Epoxy Devcon Danvers, MA 01923	Adhesive
Tak Pak® Loctite Newington, CT 06111	Adhesive and 710 accelerator
Silverstat Soldapullt® Edsyn Van Nuys, CA 91406	Desoldering tool model AS196
Crocus cloth	
Isopropyl alcohol	
Acid brush	
Cotton swabs	
Vacuum cleaner	
Soft-bristle brush	Nonmetallic
Cloth	Clean and lint-free
Compressed air	Clean and dry (60psi, max.)

Note: ® *This symbol indicates a registered trademark.*

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Cleaning Procedures

Clean the instrument after maintenance, disassembly, or any repair procedure.

External Cleaning

Clean the instrument case, cables, and screen with mild soap and water. Use only a damp sponge or towel to clean.

Warning — **SHOCK OR FIRE HAZARD.** Do not immerse any portion of the instrument in water. Fluid spills and splashes may damage electrical components.

Warning — **SHOCK HAZARD FROM ACCUMULATED GEL.** Clean the instrument paddles after each use.

Caution — **Possible Instrument Damage.** Do not autoclave the instrument.

Interior Cleaning

Follow disassembly procedures (beginning page 4–4) to access instrument interior.

Warning — **SAFETY HAZARD.** Ventilate work area when using solvents. Observe manufacturer warnings regarding personnel safety and emergency first aid. Keep first aid equipment available when using chemicals.

Warning — **CHEMICAL FIRE HAZARD.** Observe shop safety and fire precautions. Store solvents and solvent-soaked rags in approved containers. Refer to manufacturers instructions on containers for recommended firefighting procedures. Keep firefighting equipment available.

Caution — **Possible Component Damage.** This instrument contains static sensitive devices (SSDs). Use special handling procedures, page 4–4.

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Caution	**Possible Component Damage.** Do not use solvents to clean transformers or inductors.

1. Brush surfaces and parts with a nonmetallic soft-bristle brush. Remove loosened dirt and dust using dry low pressure compressed air (60psi) or a vacuum cleaner.
2. Wipe metal surfaces with a soft, nonabrasive cloth dampened with isopropyl alcohol.

Caution	**Prevent Nameplate Damage.** Do not use abrasive cleaners or solvents to wipe nameplates and labels.

3. Wipe surfaces of nameplates and labels with a clean, dry cloth.

Caution	**Possible Equipment Damage.** Do not use solvents to clean plastic parts.

4. Clean surfaces of plastic parts with a mild soap and water solution. Dry with a clean cloth.
5. Clean soldering surfaces with a nonmetallic, soft-bristle brush dipped in isopropyl alcohol then wipe with absorbent cloth. Air dry 10 minutes or use low pressure compressed air before soldering.

Printed Circuit Repair Techniques

These repair procedures provide an alternative to replacing the assembly.

Note: Damaged assemblies may be returned to Physio-Control for repair or replacement. Customer repair of an instrument under warranty may void the warranty.

- Refer to Table 4–1 and follow corrective actions if necessary.
- Before removing an assembly for repair or replacement, label each lead or draw a sketch showing the location of cables and wires. Refer to Section 5 for details on wire and cable routing as well as assembly interconnection.

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PCB Component Replacement

If replacing damaged or failing components observe the following:

Caution	**Possible PCB Damage.** Only skilled or trained personnel should attempt to solder or repair printed circuit boards.

- Some PCBs contain surface-mount components that require specialized equipment and techniques for replacement.
- Two types of solder are preferred because the flux residue is nonconductive and does not require cleaning: X–32B and Xersin 2005. Use X–32B on PCBs, and Xersin 2005 when connecting large surfaces to relatively small surfaces (e.g., connecting a wire to a transformer tab).

Caution	**Possible Component Damage.** Use a heat sink when soldering semiconductor components. Apply the minimum heat necessary to properly solder components to PCBs.

- The soldering iron tip rating must not exceed 371°C (700°F). Use the minimum heat necessary to melt the solder and form a reliable solder joint. Use a solder vacuum for solder removal.

Caution	**Possible Component Damage.** Install polarized components correctly. Do not repeatedly bend wires or component leads.

- Observe proper polarity before soldering polarized components in place. Refer to transistor indexing, tab positions, diode markings, and capacitor polarities illustrated on the component layout in Section 5.
- If replacing an electrically isolated heat-sink-mounted component, check isolation between the component tab and the heat sink with an ohmmeter before soldering the leads.

PCB Repair

Physio-Control recommends returning PCBs for repair or replacement. Multilayer PCBs contain alternate layers of conductive patterns and insulating material bonded together and interconnected with plated-thru holes. The internal layers and connection points are quickly damaged by heat, rendering the entire PCB useless.

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Shipping Assembly

Save the original shipping box and packing for the LIFEPAK 9 defibrillator/monitor. If the instrument must be shipped to the service center or factory, the special packaging is required to prevent shipping damage. Refer to Figure 4–3 when packing.

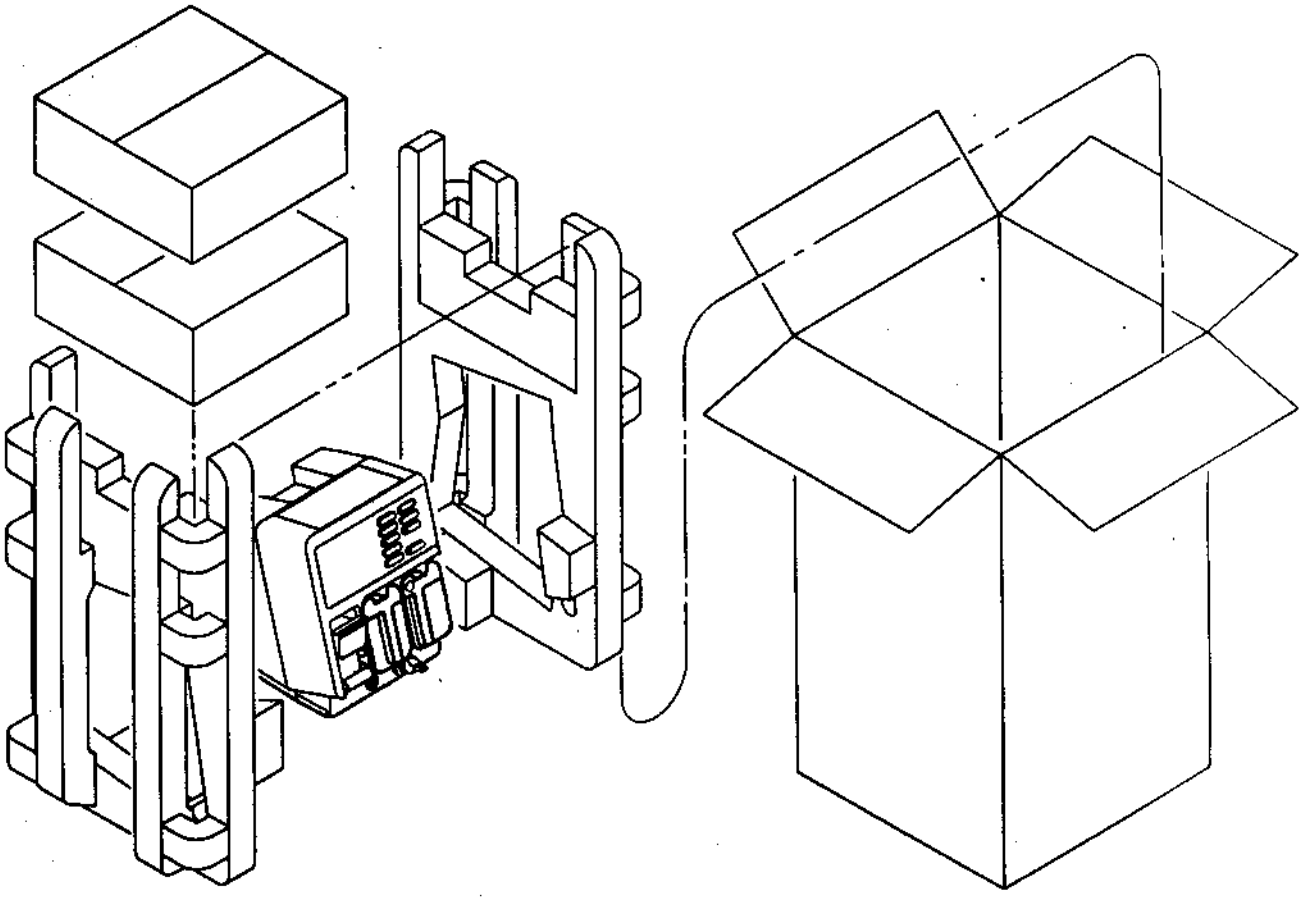

Figure 4–3 LIFEPAK 9P defibrillator/monitor Shipping Assembly

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Part No. _____

Serial No. _____

Trademarks

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Warranty

Refer to the product warranty statement included in the accessory kit shipped with the product. Duplicate copies may be obtained in the USA by calling the Physio–Control PARTSLINE at 1–800–442–1142. Outside the USA, contact your local Physio–Control sales or service office.

Use Code: Different hardware configurations and their corresponding letter codes are listed at the beginning of each parts list. Use of any letter code indicates which part is used in a particular configuration. A blank in this column indicates that the part is used in all configurations.

Qty: The quantity column specifies the *total* quantity used for each part number listed. The abbreviation REF indicates a major assembly or subassembly.

Component Layouts or Exploded Views

Use component layouts or exploded views to locate parts. The reference designator or assigned item number is listed in the REF column number on the parts list.

Schematic Diagrams

Schematic diagrams depict circuit function and signal flow. Signal names, pin numbers, and polarities are labeled on the schematics as well as reference designators and values from the parts list.

- Signal flow is generally from left to right
- Circuit names on schematics correspond to descriptions in Section 1
- ICs marked with ✻ are detailed in Section 6
- To/From labels refer signals to the interconnect diagram.

How to Order Parts

When ordering from Physio–Control Corporation call the toll free PARTSLINE number (1–800–442–1142). Give the instrument part number and serial number located on the bottom panel of your instrument. Then specify all part numbers, reference designations, and descriptions. Different parts may be substituted by Physio–Control to reflect modifications and improvements of instrument circuitry.

Table 5–1 Major Assemblies

Ref	Part Number	Nomenclature	Fig. No.	Page No.
REF	803800	**LIFEPAK 9 defibrillator/monitor**	5–1	5–13
		Interconnect Diagram	5–2	5–14
A1	803715	Main PCB Assembly ⚠	5–3	5–24
A2	803726	Power Supply PCB Assembly	5–4	5–32
A3	803724	Power Conversion PCB Assembly ⚠	5–5	5–41
A4	803706	Display Assembly	5–6	5–46
A5	803761	Interconnect PCB Assembly ⚠	5–7	5–57
A6	803745	Front Panel Assembly	5–8	5–60
A7	803741	Rear Panel Membrane Switch	5–10	5–62
A8	804189	Strip Chart Recorder Assembly ⚠	5–11	5–64
A9	800240	Transfer Relay Assembly	5–12	5–66
A10	802901	Paddle Assembly	5–13	5–67
A11		Chassis/Harness Assembly	N/A	N/A
W1	803783–18	Power Supply PCB/AC Receptacle/Ground Wire Harness	5–14	5–69
W2	803783–23	Power Conversion PCB/Power Supply PCB/Battery Wire Harness	5–15	5–70
W3	803783–24	Battery Sensor/Power Supply PCB Wire Harness	5–16	5–71
W4	803756–13	High Voltage Connector Cable Assembly	5–17	5–72
W5	803733–00	Main PCB/Display Cable Assembly	5–18	5–73
W6	803773–00	Main PCB/Recorder Cable Assembly	5–19	5–74
W7	803772–00	Interconnect PCB/Front Panel Cable Assembly	5–20	5–75
W8	803783–00	Main PCB/Patient Connector Wire Harness	5–21	5–76
W9	803783–04	AC Receptacle/Ground Wire Harness	5–22	5–77
W10	803783–05	AC Receptacle Wire Harness	5–23	5–77
W11	803783–06	Test Load Contact/Resistor Wire Harness	5–24	5–78
W12	803783–07	Power Conversion PCB/Reed Assembly Wire Harness	5–25	5–78
W13	803783–08	Power Conversion PCB/Dump Relay Wire Harness	5–26	5–79
W14	803783–09	Power Conversion PCB/Charge Relay Negative Wire Harness	5–27	5–80
W15	803783–10	Power Conversion PCB/Charge Relay Positive Wire Harness	5–28	5–81
W16	803783–11	Main PCB/Sternum Relay Wire Harness	5–29	5–82
W17	803783–12	Main PCB/Apex Relay Wire Harness	5–30	5–82
W18	803783–13	Storage Capacitor Positive/Relay Wire Harness	5–31	5–83
W19	803783–14	Storage Capacitor Negative/Relay Wire Harness	5–32	5–83
W20	803783–15	ECG Out Wire Harness	5–33	5–84
W21	803783–19	Recorder/Bracket Ground Wire Harness	5–34	5–85

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Table 5–2 Defibrillation Adapter Assemblies

Ref	Part Number	Nomenclature	Fig. No.	Page No.
REF	803747	**Defibrillation Adapter**	5–35	5–87
W1	803774–03	Test Load High Voltage Wire Harness	5–36	5–89
W2	803774–04	Test Load High Voltage Wire Harness	5–37	5–89
W3	803774–05	Pushbutton Switch Wire Harness	5–38	5–90
W4	803756–09	High Voltage Connector Cable Assembly	5–39	5–91

Table 5–3 Reference Designator Key

Designator	Description
A	Main Assemblies
C	Capacitor
CR or D	Diode
F	Fuse
H	Heat Sink
J	Jack Connector
JP	Jumper Wire
K	Relay
L	Inductor
P	Plug Connector
Q	Transistors
R	Resistor
RN	Resistor Network
RV	Varistor
RT	Thermistor
S	Switch
T	Transformer
TP	Test Point
U	IC (Integrated Circuit)
VSP	Voltage Surge Protector
W	Wire Harness
Y	Crystal
XU	IC Socket

Supplies and Accessories

Supplies and accessories for the LIFEPAK 9 defibrillator/monitor are listed in Table 5–4. the Physio–Control part number is listed for each item. To order an item, call the Physio–Control PARTSLINE at 1–800–442–1142.

Table 5–4 Supplies and Accessories

Description	Quantity	Part Number
Cable, Patient	3–lead, AHA	9–10418–02
	3–lead, IEC	800947–01
Cord, Power		803619–08
DERMA JEL Electrode Jelly	4 ounce tube	9–10236–00
	Case, (12 tubes)	9–10236–012
Electrode, FAST–PATCH disposable defibrillation *(Use with LIFEPAK 9 defibrillation adapter PN803747.)*	804545–001	1 set (2 electrodes)
	804545–010	10 sets (20 electrodes)
	804545–050	50 sets (100 electrodes)
Electrode, LIFE•PATCH, pre–gelled (disposable)	Box of 30	800139–030
	Case of 300	800139–300
Electrode, Welsh suction cup, 18mm		200521–000
Instruction Sheet, Internal Paddles		800806–04
Operating Instructions		803762–00
Paper, ECG, Chemical, 50 mm x 30mm (100ft), 40 mm grid	Box of 3 rolls	804700–003
	Case (150 rolls)	804700–150
Paddle, Internal, Specify Size *(Use with handles and connector 800441–03.)*	2.5cm (1.0in) dia., pair	802154–10
	3.8cm (1.5in) dia., pair	802154–11
	5.1cm (2.0in) dia., pair	802154–12
	6.4cm (2.5in) dia., pair	802154–13
	8.9cm (3.5in) dia., pair	802154–14
Paddle, Pediatric, external, 2 required		800418–00
Paddle, Posterior, external, adult		802461–00
Service Manual		803763–05
Shipping Container, Battery Recycling Pb		805984–01
Shock Advisory Adapter		803732–00

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5–1 Ref	Part Number	Description	Use Code	Qty
		LIFEPAK 9 defibrillator/monitor:		
	803800–01	French, 220V	A	REF
	803800–02	German, 220V	B	REF
	803800–03	Spanish, 220V	C	REF
	803800–04	Spanish, 110V	D	REF
	803800–05	French, 120V	E	REF
	803800–06	French, CSA, 120V	F	REF
	803800–07	English, CSA, 120V	G	REF
	803800–08	English, UK, 220V	H	REF
	803800–09	English, 120V	I	REF
	803800–10	French, 220V	J	REF
	803800–11	German, 220V	K	REF
	803800–12	Spanish, 220V	L	REF
	803800–13	Spanish, 110V	M	REF
	803800–14	French, 120V	N	REF
	803800–15	French, CSA, 120V	O	REF
	803800–16	English, CSA, 120V	P	REF
	803800–17	English, UK, 220V	Q	REF
	803800–18	English, 120V	R	REF
	803800–19	French, 220V	S	REF
	803800–20	German, 220V	T	REF
	803800–21	Spanish, 220V	U	REF
	803800–22	Spanish, 110V	V	REF
	803800–23	French, 120V	W	REF
	803800–24	French, CSA, 120V	X	REF
	803800–25	English, CSA, 120V	Y	REF
	803800–26	English, UK, 220V	Z	REF
	803800–28	English, 120V	AA	REF
	803800–29	French, 120V	AB	REF
	803800–30	German, 220V	AC	REF
	803800–31	Spanish, 220V	AD	REF
	803800–32	Spanish, 110V	AE	REF
	803800–33	French, 120V	AF	REF
	803800–34	French, CSA, 120V	AG	REF
	803800–35	English, CSA, 120V	AH	REF

5–1 Ref	Part Number	Description	Use Code	Qty
		LIFEPAK 9 defibrillator/monitor:		
	803800–01	French, 220V	A	REF
	803800–36	English, UK, 220V	AI	REF
	803800–300	English, 120V, ECG OUT	AJ	REF
	803800–301	French, 220V	AK	REF
	803800–303	Spanish, 220V	AL	REF
	803800–304	Spanish, 110V	AM	REF
	803800–305	French, 120V	AN	REF
	803800–306	French, CSA, 120V	AO	REF
	803800–307	English, CSA, 120V	AP	REF
	803800–308	English, UK, 220V	AQ	REF
	803800–309	Portuguese, 110V	AR	REF
	803800–310	Portuguese, 220V	AS	REF
	803800–311	Italian, 220V	AT	REF
	803800–312	Swedish, 220V	AU	REF
	803800–313	German, 220V	AV	REF
	803800–314	English (Japan), 120V, ECG OUT	AW	REF
A1	803715–11	Main PCB Assembly ⚠ (pg. 5–24) ***Note:*** *If ordering a Main PCB Assembly, order U14 and U27 separately. See parts list.*		1
A2	803726–01	Power Supply PCB Assembly (pg. 5–32)		1
A3	803724–03	Power Conversion PCB Assembly ⚠ (pg. 5–41)		1
A4	803706–00	Display Assembly (pg. 5–46)	AJ–AO, AQ–AT,AW	
	803706–01	Display Assembly	AU,AV	1
A5	803761–02	Interconnect PCB Assembly ⚠ (pg. 5–57)	AJ–AW	1
A6	803745–00	Front Panel Assembly, English (pg. 5–60)	I,G,H,P–R,Y,Z,AA,AH,AI,AJ, AP,AQ,AW	1
	803745–01	Front Panel Assembly, French	A,E,F,J,N,O,S,W,X,AB,AF, AG,AK,AN,AO	1
	803745–02	Front Panel Assembly, German	B,K,T,AC,AV	1
	803745–03	Front Panel Assembly, Spanish	C,D,L,M,U,V,AD,AE,AL,AM	1
	803745–04	Front Panel Assembly, Portuguese	AR,AS	1
	803745–05	Front Panel Assembly, Italian	AT	1
	803745–06	Front Panel Assembly, Swedish	AU	1
A7	803741–01	Rear Panel Switch Membrane (pg. 5–62)		1

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5–1 Ref	Part Number	Description	Use Code	Qty
A8	804189–00	Strip Chart Recorder Assembly ⚠ (pg. 5–64)		1
A9	800240–11	Transfer Relay Assembly (pg. 5–66)		1
A10	802901–06	Paddle Assembly (pg. 5–67)		1
W1	803783–18	Power Supply/AC Receptacle/Ground Wire Harness (pg. 5–69)		1
W2	803783–23	Power Conversion PCB/Power Supply/Battery Wire Harness (pg. 5–70)		1
W3	803783–24	Battery Sensor/Power Supply PCB Wire Harness (pg. 5–71)		1
W4	803756–13	High Voltage Connector Cable Assembly (pg. 5–72)		1
W5	803733–00	Main PCB/Display PCB Cable Assembly (pg. 5–73)		1
W6	803773–00	Main PCB/Recorder Cable Assembly (pg. 5–74)		1
W7	803772–00	Interconnect PCB/Front Panel Cable Assembly (pg. 5–75)		1
W8	803783–00	Main PCB/Patient Connector Wire Harness (pg. 5–76)		1
W9	803783–04	AC Receptacle/Ground Wire Harness (pg. 5–77)		1
W10	803783–05	AC Receptacle Wire Harness (pg. 5–77)		1
W11	803783–06	Test Load Contact/Resistor Wire Harness (pg. 5–78)		1
W12	803783–07	Power Conversion PCB/Reed Assembly Wire Harness (pg. 5–78)		1
W13	803783–08	Power Conversion PCB/Dump Relay Wire Harness (pg. 5–79)		1
W14	803783–09	Power Conversion PCB/Charge Relay Negative Wire Harness (pg. 5–80)		1
W15	803783–10	Power Conversion PCB/Charge Relay Positive Wire Harness (pg. 5–81)		1
W16	803783–11	Main PCB/Sternum Relay Wire Harness (pg. 5–82)		1
W17	803783–12	Main PCB/Apex Relay Wire Harness (pg. 5–82)		1
W18	803783–13	Storage Capacitor Positive/Relay Wire Harness (pg. 5–83)		1
W19	803783–14	Storage Capacitor Negative/Relay Wire Harness (pg. 5–83)		1
W20	803783–15	ECG Out Wire Harness (pg. 5–84)	AJ–AW	1
W21	803783–19	Recorder/Bracket Bround Wire Harness (pg. 5–85)		1
2	803704–02	**Battery Pack**		1
3	803729–02	**Bracket**, Strip Chart Recorder		1
4	803705–00	**Capacitor**, storage		1
5	803749–03	**Case**, front, with inserts		1

5–1 Ref	Part Number	Description	Use Code	Qty
6	803740–01	**Case**, rear, ECG Out		1
7	803722–05	**Chassis**, with inserts		1
8	803737–00	**Clip**, mounting, test–load resistor		2
9	803718–00	**Clip**, power entry module	AA,AJ,AR–AU,AW	1
10	201393–011	**Connector**, plug, equipotential		1
11	202110–000	**Connector**, receptacle, quick–connect, 6A/250V		1
12	803736–00	**Contact**, test load		2
13	803711–01	**Door**, battery		1
14	200363–025	**Fastener**, plastic rivet, 0.125 D		1
15	802885–00	**Foot**, mounting		4
16	200256–151	**Fuse**, slow blow, 4A/250V	D–G,J–L	2
	200619–021	**Fuse**, slow blow, 4A/250V	I,M–Z,AA,AE–AH,AJ,AM–AP,AW	2
	200619–044	**Fuse**, slow blow, 2A/250V	A–C,H,AB–AD,AI,AK,AL,AQ–AV	2
17	802793–05	**Inductor**, wave shaping		1
18	805531–00	**Label**, blank		1
19	803785–00	**Label**, CSA (not shown, next to serial number label)	AG,AH,AO,AP	1
20	803743–01	**Label**, front panel, French	A,E,F,J,N,O,S,W,X,AB,AF,AG,AK,AN,AO	1
	803743–02	**Label**, front panel, German	B,K,T,AC,AV	1
	803743–03	**Label**, front panel, Spanish	C,D,L,M,U,V,AD,AE,AL,AM	1
	803743–04	**Label**, front panel, English	I,G,H,P–R,Y,Z,AA,AH,AI,AJ,AP,AQ,AW	1
	803743–05	**Label**, front panel, Portuguese	AR,AS	1
	803743–06	**Label**, front panel, Italian	AT	1
	803743–07	**Label**, front panel, Swedish	AU	1
21	803742–01	**Label**, instruction, French	A,E,J,N,S,W,AB,AF,AK,AN	1
	803742–02	**Label**, instruction, German	B,K,T,AC,AV	1
	803742–03	**Label**, instruction, Spanish	C,D,L,M,U,V,AD,AE,AL,AM	1
	803742–04	**Label**, instruction, French	I,F,O,R,X,AG,AO	1
	803742–05	**Label**, instruction, English, CSA	G,I,H,P,Q,R,Y,Z,AA,AH,AI,AJ,AP,AQ,AW	1
	803742–06	**Label**, instruction, French	AR,AS	1
	803742–07	**Label**, instruction, Italian	AT	1
	803742–08	**Label**, instruction, Swedish	AU	1
22	802940–03	**Label**, paddle, APEX	A,I,R,AA	1

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5–1 Ref	Part Number	Description	Use Code
	802940–08	**Label**, paddle, APEX, Domestic	AJ,AW
	802940–11	**Label**, paddle, APEX, International	J,K,L,M,NO,P,Q,AI AV
23	802940–07	**Label**, paddle, STERNUM, Domestic (not shown, used on A10)	A,B,E–H,J,J,K,S,N Z,AA,AJ,AW
	802940–09	**Label**, paddle, STERNUM, Spanish (not shown, used on A10)	C,D,L,M,U,V,AD,AI AS
	802940–10	**Label**, paddle, STERNUM, International (not shown, used on A10)	J,K,N,O,P,Q,T,W Z AF–AI,AK,AN AC
24	803739–03	**Label**, rear panel, French	A,E,J,N,S,W,AB,AI
	803739–04	**Label**, rear panel, German	B,K,T,AC
	803739–05	**Label**, rear panel, Spanish	C,D,L,M,U,V,AL,AI
	803739–06	**Label**, rear panel, English, UK	H,Q,Z,AI
	803739–07	**Label**, rear panel, French, CSA, 120V	F,O,X,AG
	803739–08	**Label**, rear panel, English	I,G,P,Y, AA,AH
	803739–10	**Label**, rear panel, English, CSA, ECG Out	AJ,AP,AW
	803739–11	**Label**, rear panel, French, 110V/220V, ECG Out	AK,AN
	803739–12	**Label**, rear panel, German	AV
	803739–13	**Label**, rear panel, Spanish, 110V/220V, ECG Out	AL,AM
	803739–14	**Label**, rear panel, UK, 220V, ECG Out	AQ
	803739–15	**Label**, rear panel, French, CSA, 110V, ECG Out	AO
	803739–16	**Label**, rear panel, Portuguese	AR,AS
	803739–17	**Label**, rear panel, Italian	AT
	803739–18	**Label**, rear panel, Swedish	AU
25	803727–07	**Label**, serial number, French, International	A
	803727–08	**Label**, serial number, German, International	B
	803727–09	**Label**, serial number, Spanish, International	C
	803727–10	**Label**, serial number, Spanish, Domestic	D
	803727–11	**Label**, serial number, French, Domestic	E
	803727–12	**Label**, serial number, French, CSA	F
	803727–13	**Label**, serial number, English, CSA	G
	803727–14	**Label**, serial number, English, UK	H
	803727–15	**Label**, serial number, English, Domestic	I
	803727–16	**Label**, serial number, French, International	J
	803727–17	**Label**, serial number, German, International	K
	803727–18	**Label**, serial number, Spanish, International	L

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5–1 Ref	Part Number	Description	Use Code
	803727–19	**Label**, serial number, Spanish, Domestic	M
	803727–20	**Label**, serial number, French, Domestic	N
	803727–21	**Label**, serial number, French, CSA	O
	803727–22	**Label**, serial number, English, CSA	P
	803727–23	**Label**, serial number, English, UK	Q
	803727–24	**Label**, serial number, English, Domestic	R
	803727–25	**Label**, serial number, French, International	S
	803727–26	**Label**, serial number, German, International	T
	803727–27	**Label**, serial number, Spanish, International	U
	803727–28	**Label**, serial number, Spanish, Domestic	V
	803727–29	**Label**, serial number, French, Domestic	W
	803727–30	**Label**, serial number, French, CSA	X
	803727–31	**Label**, serial number, English, CSA	Y
	803727–32	**Label**, serial number, English, UK	Z
	803727–34	**Label**, serial number, English, Domestic	AA,AI,AW
	803727–35	**Label**, serial number, French, International	AB,AK
	803727–36	**Label**, serial number, German, International	AC,AV
	803727–37	**Label**, serial number, Spanish, International	AD,AL
	803727–38	**Label**, serial number, Spanish, Domestic	AE,AM
	803727–39	**Label**, serial number, French, Domestic	AF,AN
	803727–40	**Label**, serial number, French, CSA	AG,AO
	803727–41	**Label**, serial number, English, CSA	AH,AP
	803727–42	**Label**, serial number, English, UK	AI,AQ
	803727–44	**Label**, serial number, Portuguese	AR
	803727–46	**Label**, serial number, Italian	AT
	803727–48	**Label**, serial number, Swedish	AU
	803727–72	**Label**, serial number, Portuguese, 220V	AS
26	805377–06	**Label**, reference, Japanese (not shown, next to serial number label)	AW
27	801517–04	**Label**, UL (not shown, next to serial number label)	AJ
28	803456–15	**Label**, specification, battery (not shown, next to battery pack)	
29	800943–09	**Label**, high voltage symbol, International (not shown, used on A4 and A9)	
30	201508–002	**Nut**, kep, locking, #6–32	

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5–1 Ref	Part Number	Description	Use Code
31	803713–01	**Panel**, rear, ECG Out	AJ–AW
32	802935–05	**Pushbutton**, paddle, charge, Domestic	A,E–H,I,J,N–Q,R,S,A AF–AI,AJ,AK,AN A
	802935–06	**Pushbutton**, paddle, charge, German	B,K,T,AC,AV
	802935–07	**Pushbutton**, paddle, charge, Spanish	C,D,L,M,U,V,AD,AI AR,AS
	802935–18	**Pushbutton**, paddle, charge, Italian	AT
	802935–19	**Pushbutton**, paddle, charge, Swedish	AU
33	802935–08	**Pushbutton**, paddle, discharge, Domestic	D,E–G,J,N–P,R,W Y AH,AJ,AM–AP,AR,A
	802935–09	**Pushbutton**, paddle, discharge, International	A–C,H,J–L,S–U,Q,Z AD,AI,AK,AL,AQ,A
34	800516–02	**Resistor**, defibrillator (not shown, behind inductor)	
35	802608–00	**Resistor**, 50Ω, 50W, 5%	
36	200536–001	**Retainer**, cable tie, nylon, 0.10 W x 4 L (not shown)	
37	200536–011	**Retainer**, cable tie, nylon, 0.35 W x 20.9 L	
38	200040–019	**Retaining Ring**, steel, 1.127 OD	
39	201874–270	**Screw**, pan head, #4–40 x 0.312 L	
40	201874–277	**Screw**, pan head, #8–32 x 0.375 L	A–Z,AB–AI,AK–AQ
	201874–277	**Screw**, pan head, #8–32 x 0.375 L	AA,AJ,AR–AU,AW
41	201874–276	**Screw**, pan head, #6–32 x 0.375 L	
42	803768–00	**Shield**, recorder bracket	
43	803759–00	**Shield**, high voltage, Power Conversion PCB	
44	803717–01	**Shield**, preamp, circuit–side	
45	803716–01	**Shield**, preamp, component–side	
46	202250–003	**Sleeve**, ferrite snap (not shown, near connector, REF 11, receptacle on rear panel)	AU,AV
47	803730–00	**Spacer**, battery pack (not shown, under battery door)	
48	201625–171	**Spring**, compression, 0.300 OD, 0.562 L	
49	803735–01	**Spring**, paddle retention	
50	200192–294	**Standoff**, hex, 0.312 W x 1.875 L	
51	201501–012	**Tape**, adhesive foam, 0.125 THK x 1 W (not shown, under W12)	
52	200283–005	**Tubing**, heat shrink, red, 0.250 ID (not shown, used on connector receptacle)	
53	90–04053	**Washer**, flat, 0.375 OD, 0.152 ID, 0.045 T	
54	200804–101	**Washer**, flat, #8	

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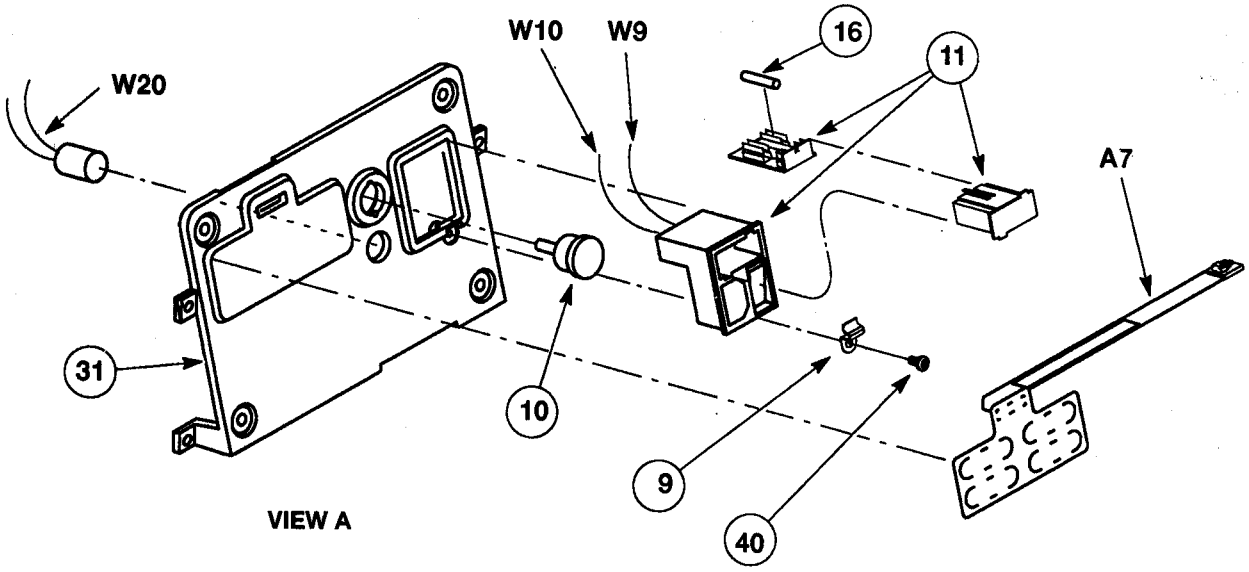
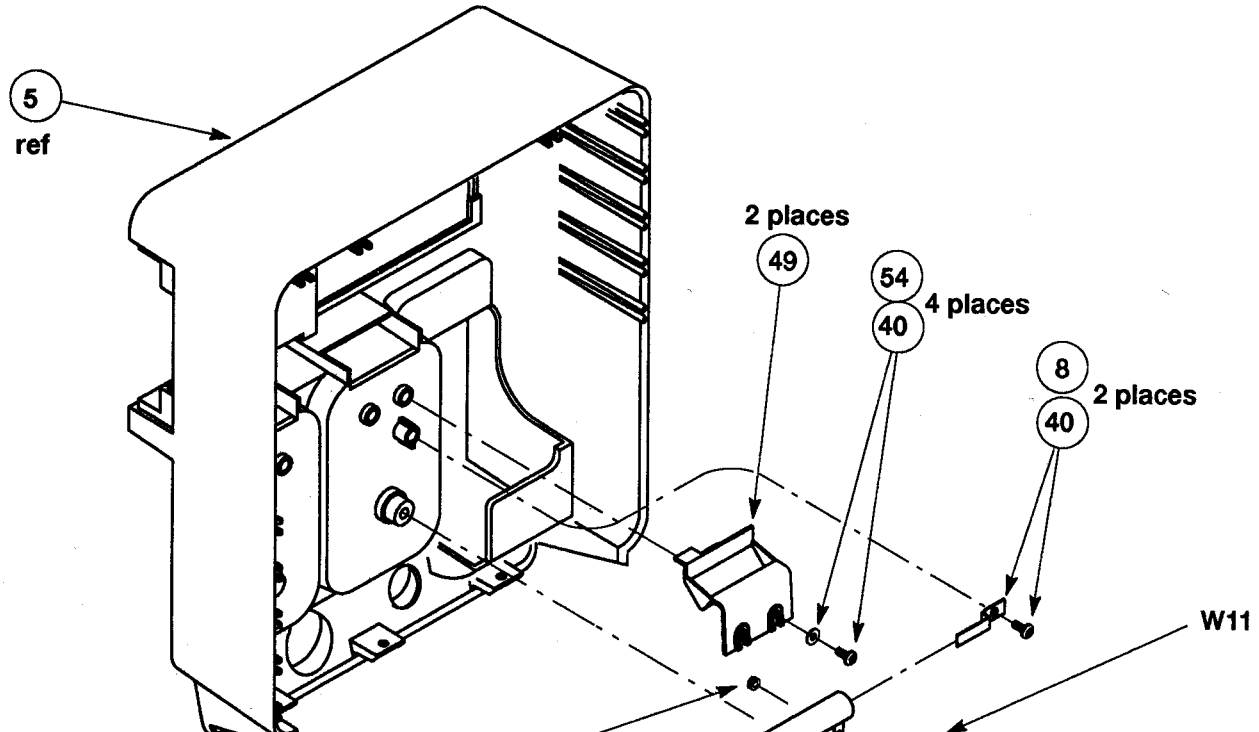
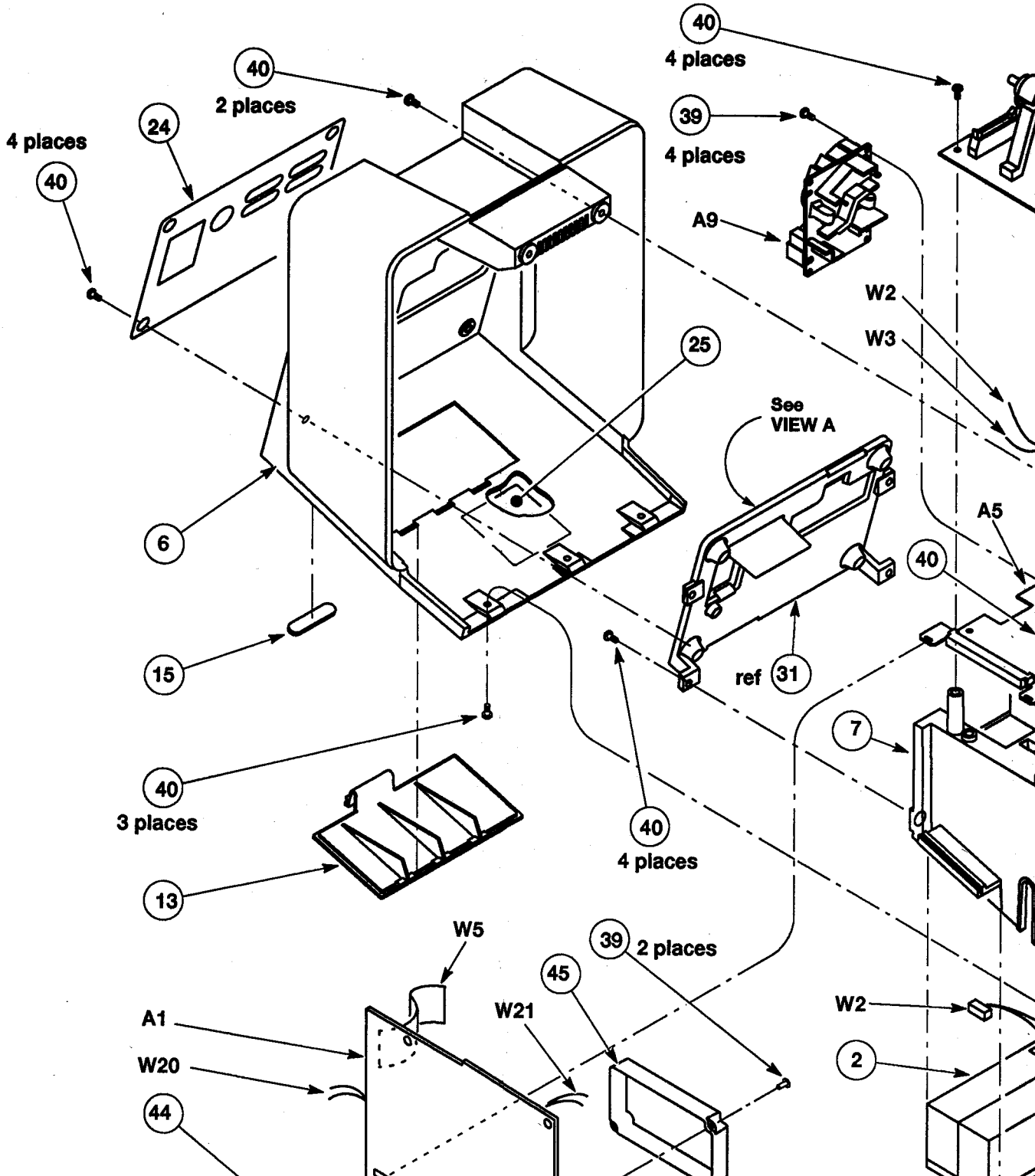
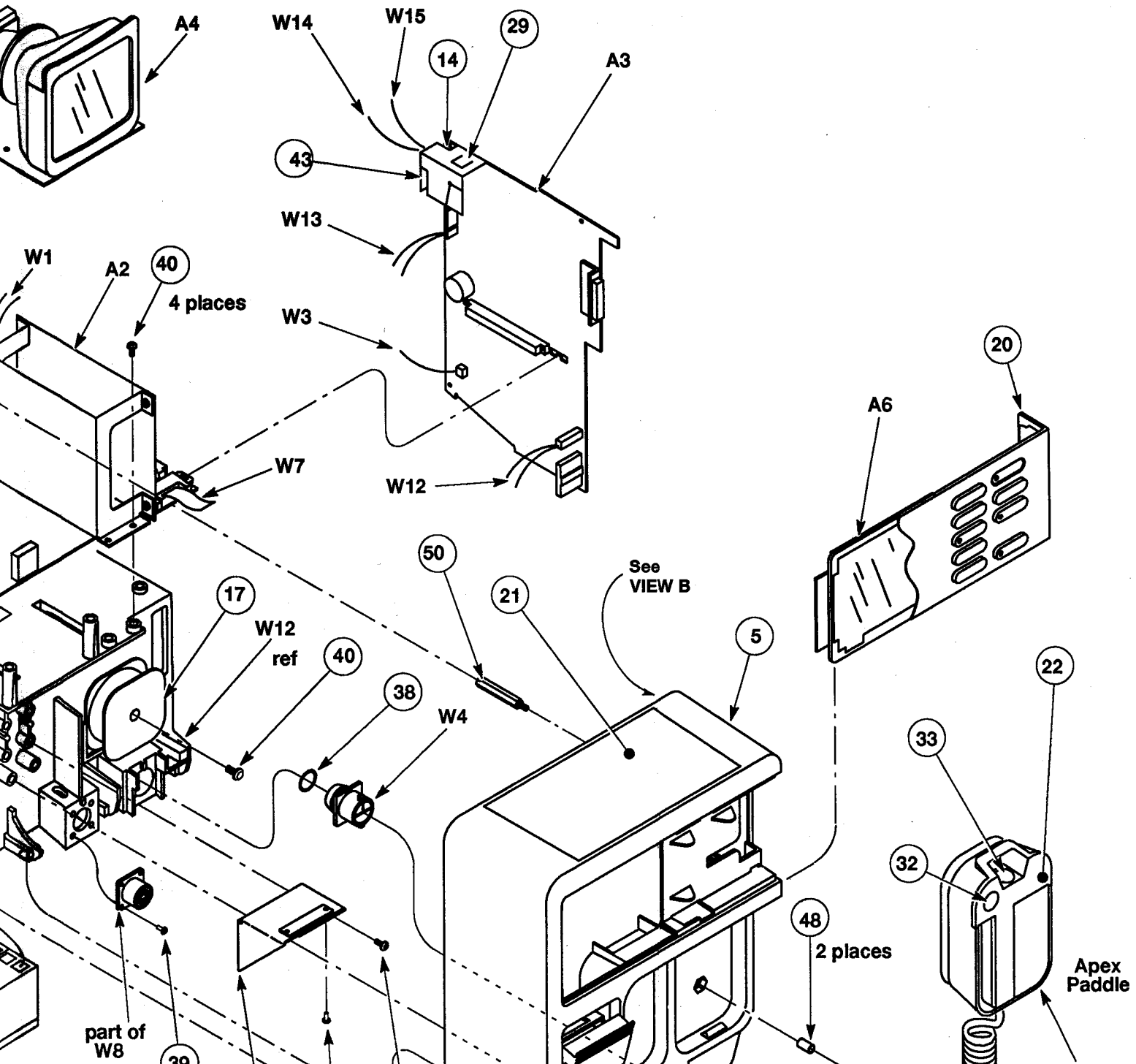
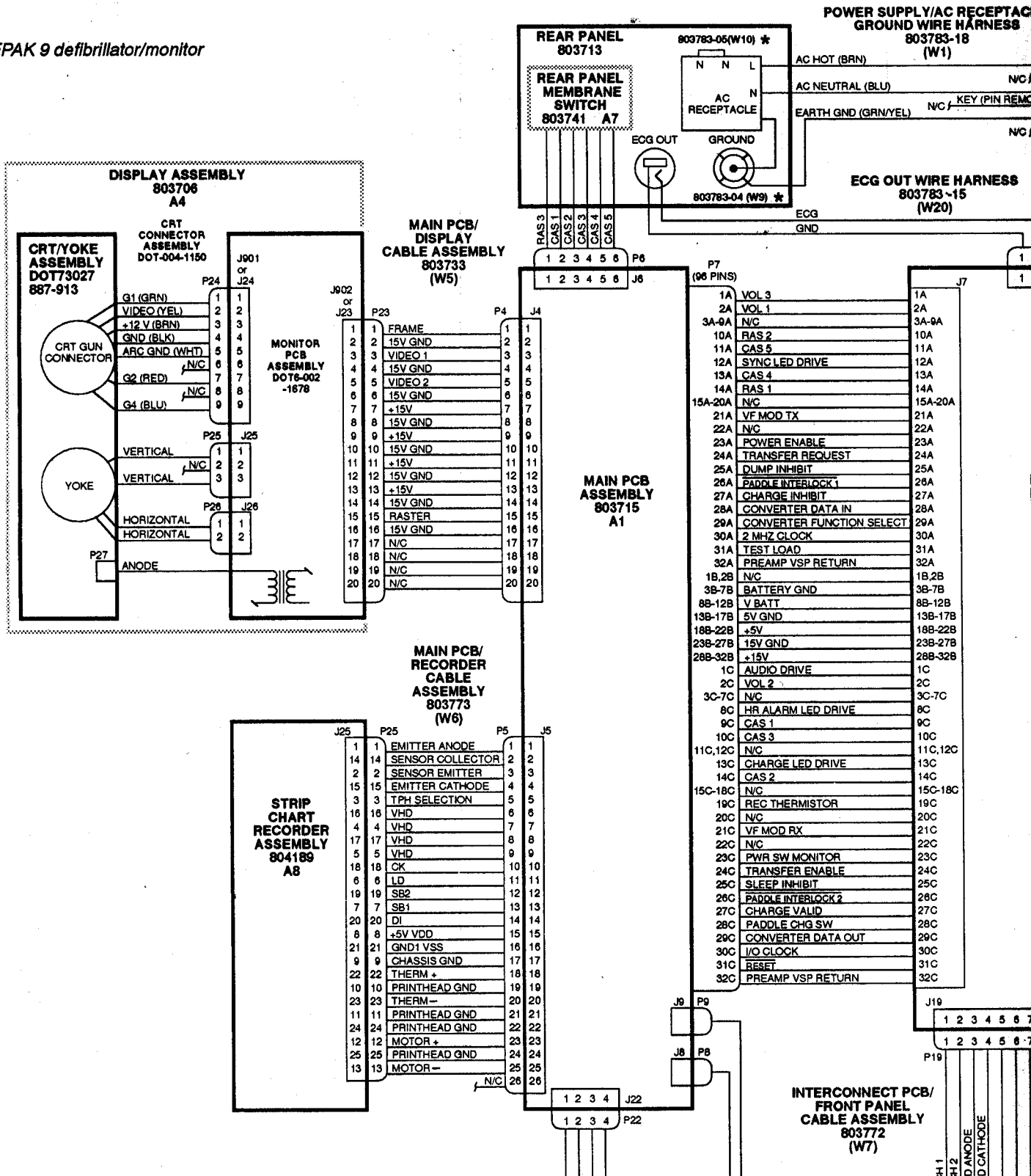

W20
W10
W9
16
11
A7
31
10
9
40

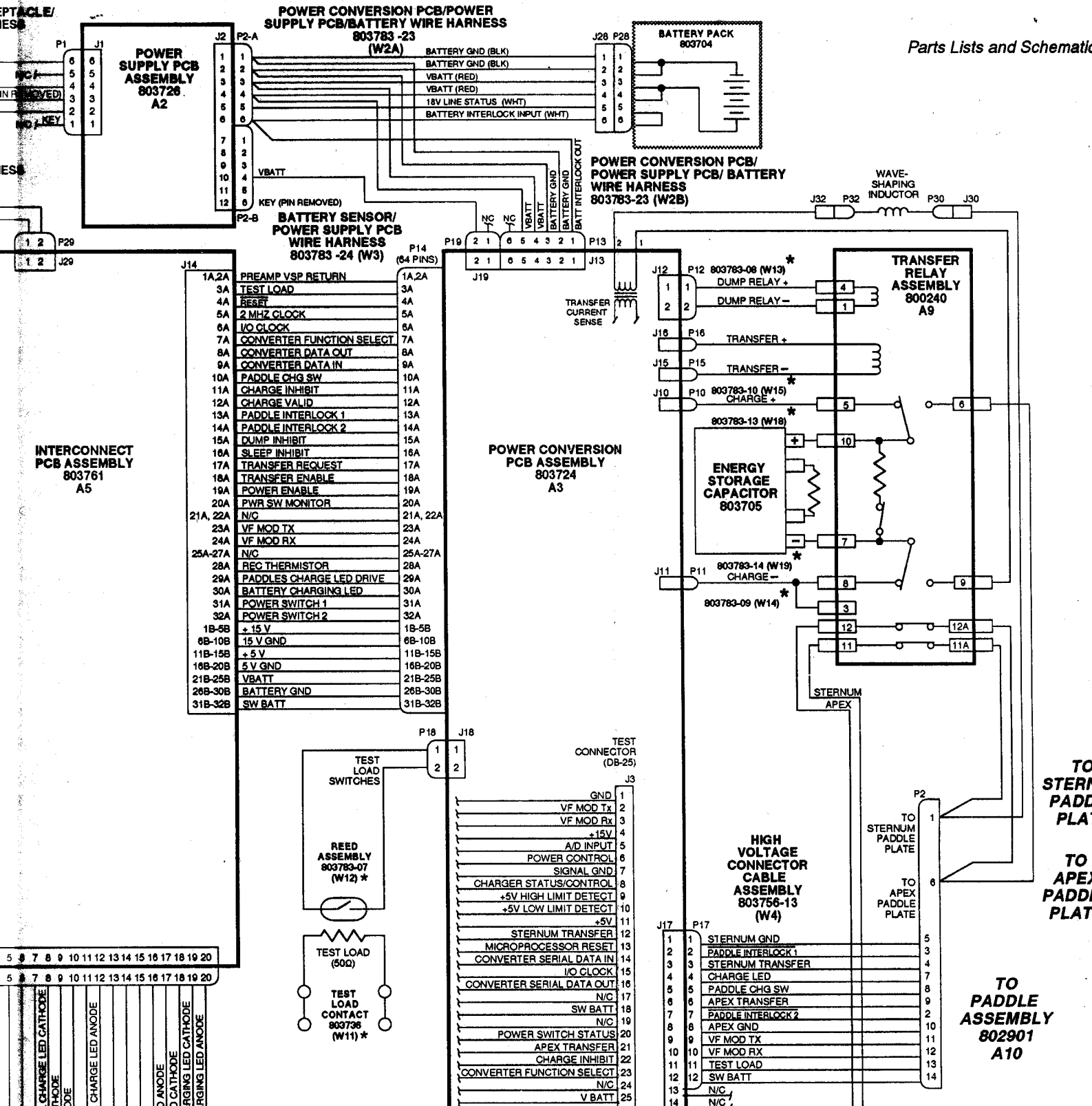
VIEW A


5
ref
2 places
49
54
40
4 places
8
40
2 places
W11


40
4 places
40
2 places
24
4 places
40
39
4 places
A9
W2
W3
25
See
VIEW A
6
A5
40
15
ref
31
7
40
3 places
40
4 places
13
W5
39
2 places
45
A1
W21
W2
W20
2
44


A4
W14
W15
29
14
A3
43
W13
W1
A2
40
4 places
W3
W7
W12
20
A6
50
21
See
VIEW B
5
17
W12
ref
40
38
W4
22
33
32
48
2 places
Apex
Paddle
part of
W8
39


POWER SUPPLY/AC RECEPTAC
GROUND WIRE HARNESS
803783-18
(W1)
REAR PANEL
803713
REAR PANEL
MEMBRANE
SWITCH
803741 A7
803783-05(W10) *
N N L
AC N
RECEPTACLE
AC HOT (BRN)
AC NEUTRAL (BLU)
EARTH GND (GRN/YEL)
N/C
KEY (PIN REMO
ECG OUT
GROUND
803783-04 (W9) *
ECG OUT WIRE HARNESS
803783-15
(W20)
ECG
GND
RAS 3
CAS 1
CAS 2
CAS 3
CAS 4
CAS 5
DISPLAY ASSEMBLY
803706
A4
CRT/YOKE
ASSEMBLY
DOT73027
887-913
CRT
CONNECTOR
ASSEMBLY
DOT-004-1150
CRT GUN
CONNECTOR
YOKE
G1 (GRN)
VIDEO (YEL)
+12 V (BRN)
GND (BLK)
ARC GND (WHT)
G2 (RED)
G4 (BLU)
VERTICAL
VERTICAL
HORIZONTAL
HORIZONTAL
ANODE
P24
P25
P26
P27
J901
or
J24
J25
J26
MONITOR
PCB
ASSEMBLY
DOT6-002
-1678
J902
or
J23
MAIN PCB/
DISPLAY
CABLE ASSEMBLY
803733
(W5)
P23
P4
J4
FRAME
15V GND
VIDEO 1
VIDEO 2
+15V
RASTER
N/C
P6
J6
P7
(96 PINS)
J7
MAIN PCB
ASSEMBLY
803715
A1
1A VOL 3
2A VOL 1
3A-9A N/C
10A RAS 2
11A CAS 5
12A SYNC LED DRIVE
13A CAS 4
14A RAS 1
15A-20A N/C
21A VF MOD TX
22A N/C
23A POWER ENABLE
24A TRANSFER REQUEST
25A DUMP INHIBIT
26A PADDLE INTERLOCK 1
27A CHARGE INHIBIT
28A CONVERTER DATA IN
29A CONVERTER FUNCTION SELECT
30A 2 MHZ CLOCK
31A TEST LOAD
32A PREAMP VSP RETURN
1B,2B N/C
3B-7B BATTERY GND
8B-12B V BATT
13B-17B 5V GND
18B-22B +5V
23B-27B 15V GND
28B-32B +15V
1C AUDIO DRIVE
2C VOL 2
3C-7C N/C
8C HR ALARM LED DRIVE
9C CAS 1
10C CAS 3
11C,12C N/C
13C CHARGE LED DRIVE
14C CAS 2
15C-18C N/C
19C REC THERMISTOR
20C N/C
21C VF MOD RX
22C N/C
23C PWR SW MONITOR
24C TRANSFER ENABLE
25C SLEEP INHIBIT
26C PADDLE INTERLOCK 2
27C CHARGE VALID
28C PADDLE CHG SW
29C CONVERTER DATA OUT
30C I/O CLOCK
31C RESET
32C PREAMP VSP RETURN
MAIN PCB/
RECORDER
CABLE
ASSEMBLY
803773
(W6)
STRIP
CHART
RECORDER
ASSEMBLY
804189
A8
J25
P25
P5
J5
EMITTER ANODE
SENSOR COLLECTOR
SENSOR EMITTER
EMITTER CATHODE
TPH SELECTION
VHD
CK
LD
SB2
SB1
DI
+5V VDD
GND1 VSS
CHASSIS GND
THERM +
PRINTHEAD GND
THERM –
MOTOR +
MOTOR –
N/C
J9
P9
J8
P8
J19
P19
J22
P22
INTERCONNECT PCB/
FRONT PANEL
CABLE ASSEMBLY
803772
(W7)


POWER CONVERSION PCB/POWER SUPPLY PCB/BATTERY WIRE HARNESS 803783 -23 (W2A)
POWER SUPPLY PCB ASSEMBLY 803726 A2
BATTERY PACK 803704
BATTERY GND (BLK)
BATTERY GND (BLK)
VBATT (RED)
VBATT (RED)
18V LINE STATUS (WHT)
BATTERY INTERLOCK INPUT (WHT)
KEY (PIN REMOVED)
BATTERY SENSOR/ POWER SUPPLY PCB WIRE HARNESS 803783 -24 (W3)
POWER CONVERSION PCB/ POWER SUPPLY PCB/ BATTERY WIRE HARNESS 803783-23 (W2B)
WAVE-SHAPING INDUCTOR
TRANSFER RELAY ASSEMBLY 800240 A9
DUMP RELAY +
DUMP RELAY –
TRANSFER +
TRANSFER –
803783-10 (W15) CHARGE +
803783-13 (W18)
ENERGY STORAGE CAPACITOR 803705
803783-14 (W19) CHARGE –
803783-09 (W14)
TRANSFER CURRENT SENSE
INTERCONNECT PCB ASSEMBLY 803761 A5
POWER CONVERSION PCB ASSEMBLY 803724 A3
PREAMP VSP RETURN
TEST LOAD
RESET
2 MHZ CLOCK
I/O CLOCK
CONVERTER FUNCTION SELECT
CONVERTER DATA OUT
CONVERTER DATA IN
PADDLE CHG SW
CHARGE INHIBIT
CHARGE VALID
PADDLE INTERLOCK 1
PADDLE INTERLOCK 2
DUMP INHIBIT
SLEEP INHIBIT
TRANSFER REQUEST
TRANSFER ENABLE
POWER ENABLE
PWR SW MONITOR
N/C
VF MOD TX
VF MOD RX
N/C
REC THERMISTOR
PADDLES CHARGE LED DRIVE
BATTERY CHARGING LED
POWER SWITCH 1
POWER SWITCH 2
+ 15 V
15 V GND
+ 5 V
5 V GND
VBATT
BATTERY GND
SW BATT
TEST LOAD SWITCHES
REED ASSEMBLY 803783-07 (W12) *
TEST LOAD (50Ω)
TEST LOAD CONTACT 803736 (W11) *
TEST CONNECTOR (DB-25)
GND
VF MOD Tx
VF MOD Rx
+15V
A/D INPUT
POWER CONTROL
SIGNAL GND
CHARGER STATUS/CONTROL
+5V HIGH LIMIT DETECT
+5V LOW LIMIT DETECT
+5V
STERNUM TRANSFER
MICROPROCESSOR RESET
CONVERTER SERIAL DATA IN
I/O CLOCK
CONVERTER SERIAL DATA OUT
N/C
SW BATT
N/C
POWER SWITCH STATUS
APEX TRANSFER
CHARGE INHIBIT
CONVERTER FUNCTION SELECT
N/C
V BATT
HIGH VOLTAGE CONNECTOR CABLE ASSEMBLY 803756-13 (W4)
STERNUM APEX
TO STERNUM PADDLE PLATE
TO APEX PADDLE PLATE
STERNUM GND
PADDLE INTERLOCK 1
STERNUM TRANSFER
CHARGE LED
PADDLE CHG SW
APEX TRANSFER
PADDLE INTERLOCK 2
APEX GND
VF MOD TX
VF MOD RX
TEST LOAD
SW BATT
N/C
N/C
TO PADDLE ASSEMBLY 802901 A10

5–3 Ref	Part Number	Description	Use Cou...	Qty
A1	**803715–11**	**Main PCB Assembly** ***Note:*** *If ordering a Main PCB Assembly, order U14 and U27 separately.*		
C2	201628–006	**Capacitor**, 0.01µF/50V, 5%		
C3		NOT INSTALLED		
C4		(Same as C2)		
C5	200901–026	**Capacitor**, 220pF/50V, 5%		
C6	202102–032	**Capacitor**, electrolytic, 100µF/35V, 100%		
C7	200701–006	**Capacitor**, electrolytic, 33µF/16V, 100%		
C8,11	200893–042	Capacitor, 0.47µF/50V, 10%		
C12	201628–000	Capacitor, 0.001µF/50V, 5%		
C13–15		(Same as C8)		
C16	200901–046	**Capacitor**, 0.01µF/50V, 10%		
C17		(Same as C12)		
C18		(Same as C8)		
C19		(Same as C12)		
C20	200893–051	**Capacitor,** 100pF/100V, 10%		
C21,22		(Same as C8)		
C23–27		(Same as C12)		
C28,29		(Same as C8)		
C30	201628–018	**Capacitor,** 1.0µF/50V, 5%		
C31	201628–012	**Capacitor**, 0.1µF/50V, 5%		
C32		(Same as C16)		
C33		(Same as C31)		
C34		(Same as C12)		
C35		(Same as C8)		
C36,37		(Same as C12)		
C38–42		(Same as C8)		
C43–51		(Same as C12)		
C52		(Same as C8)		
C53–56		(Same as C12)		
C57		(Same as C8)		

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5–3 Ref	Part Number	Description	Use Code	Qty
C59	200205–028	**Capacitor,** electrolytic, 100µF/25V, 10%		1
C60		(Same as C8)		
C61–71		(Same as C12)		
C72	201628–008	**Capacitor,** 0.022µF/50V, 5%		1
C73	200049–039	**Capacitor,** 0.1µF/100V, 20%		11
C74		(Same as C2)		
C75		(Same as C73)		
C76	200901–274	**Capacitor,** 0.001µF/50V, 1%		1
C77		(Same as C2)		
C78,79		(Same as C73)		
C80		(Same as C8)		
C81–83		(Same as C73)		
C84		(Same as C8)		
C85		(Same as C20)		
C86,87	200701–021	**Capacitor,** electrolytic, 10µF/35V, 20%		2
C88,90		(Same as C30)		
C91–93		(Same as C2)		
C94		(Same as C12)		
C95,96		(Same as C73)		
C97		(Same as C72)		
C98		(Same as C12)		
C99	201628–002	**Capacitor,** 2200pF/50V, 5%		1
C100, 101		(Same as C73)		
C102, 103	200901–134	**Capacitor,** 22pF/50V		4
C104	201628–016	**Capacitor,** 0.47µF/50V, 5%		1
C105		(Same as C12)		
C106	200744–021	**Capacitor,** 2µF/50V, 5%		1
C107,108		(Same as C102)		1
C109	200901–013	**Capacitor,** 18pF/50V, 5%		1
CR1	200658–002	**Diode,** fast recovery, MR812, 200ns, PIV 200		1
CR2	200971–000	**Diode,** switching, 1N914B, 8ns, PIV 75		21
CR3	200086–006	**Diode,** Zener, 1N4620, 80mA/3.3V		1

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5–3 Ref	Part Number	Description	Use Code	Qty
CR4–6		(Same as CR2)		
CR7–9	200605–010	**Diode**, Zener, 1N4738A, 550mA/8.2V		
CR10–17		(Same as CR2)		
CR18,19	200086–019	**Diode**, Zener, 1N4104, 24.8mA/10V		
CR21–28		(Same as CR2)		
CR31		(Same as CR7)		
J4	201191–221	**Connector**, locking, 20 contact		
J5	201191–222	**Connector**, locking, 26 contact		
J6	202128–028	**Connector**, header, 6 contact		
J8	201504–003	**Connector**, spade terminal, 0.187		
J9	201504–004	**Connector**, spade terminal, 0.25		
J22	202128–026	**Connector**, 4 contact		
K1	202045–000	**Relay**, 1500V, 60W		
L1	201409–036	**Inductor**, 100mH, 5%		
L2,3	200808–000	**Inductor**, ferrite bead		
P7	201678–022	**Connector**, 96 contact		
Q1	200585–001	**Transistor**, FET, VN0106N3, TO–92 ▲		
Q2	200942–001	**Transistor**, NPN, PN2222, TO–92		
Q3	202155–000	**Transistor**, FET, IRFD9010 ▲		
Q4	200994–001	**Transistor**, FET, IRF9531, TO–220 ▲		
Q5,6		(Same as Q1)		
Q7	200885–000	**Transistor**, FET, U1898, TO–92 ▲		
Q8,9		(Same as Q1)		
Q10	200582–004	**Transistor**, FET, VCR7N, TO–72 ▲		
Q11	202179–001	**Transistor**, FET, J175, TO–92 ▲		
R1,2	200054–257	**Resistor**, 4.7kΩ, 1/8W, 1%, RN55C		
R3	200054–384	**Resistor**, 100kΩ, 1/8W, 1%, RN55C		
R4–6		(Same as R1)		

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5–3 Ref	Part Number	Description	Use Code	Qty
R7	200054–363	Resistor, 60.4kΩ, 1/8W, 1%, RN55C		3
R8	200527–009	Potentiometer, 10kΩ, 1/2W		1
R9	200054–480	Resistor, 1MΩ, 1/8W, 1%, RN55C		2
R10	200054–222	Resistor, 2kΩ, 1/8W, 1%, RN55C		1
R11	200054–288	Resistor, 10kΩ, 1/8W, 1%, RN55C		1
R12	200054–259	Resistor, 4.99kΩ, 1/8W, 1%, RN55C		1
R13		(Same as R10)		
R14	200054–417	Resistor, 221kΩ, 1/8W, 1%, RN55C		1
R15	200054–279	Resistor, 8.06kΩ, 1/8W, 1%, RN55C		1
R16		(Same as R11)		
R17		(Same as R7)		
R18	200054–317	Resistor, 20kΩ, 1/8W, 1%, RN55C		1
R19	200270–048	Resistor, 10Ω, 2W, 5%		1
R20		NOT INSTALLED		
R21	200054–126	Resistor, 200Ω, 1/8W, 1%,		1
R22	200054–073	Resistor, 56.2Ω, 1/8W, 1%, RN55C		1
R23		(Same as R10)		
R24	200054–193	Resistor, 1kΩ, 1/8W, 1%, RN55C		1
R25		(Same as R18)		
R26		(Same as R9)		
R27	200216–002	Resistor, 0.2Ω, 1W, 1%		1
R28	200054–345	Resistor, 39.2kΩ, 1/8W, 1%, RN55C		1
R29,30		(Same as R18)		
R31,32		(Same as R1)		
R33	200054–164	Resistor, 499Ω, 1/8W, 1%, RN55C		1
R34		(Same as R3)		
R35		(Same as R18)		
R36	200471–031	Resistor, 20Ω, 1/2W, 5%		1
R37	200054–097	Resistor, 100Ω, 1/8W, 1%, RN55C		1
R38		(Same as R12)		
R39		(Same as R1)		
R40	200054–226	Resistor, 2.21kΩ, 1/8W, 1%, RN55C		1

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5–3 Ref	Part Number	Description	Use Code
R41	200054–413	**Resistor**, 200kΩ, 1/8W, 1%, RN55C	
R42–44		(Same as R40)	
R45	200054–451	**Resistor**, 499kΩ, 1/8W, 1%, RN55C	
R46	200054–318	**Resistor**, 20.5kΩ, 1/8W, 1%, RN55C	
R47	200054–335	**Resistor**, 30.9kΩ, 1/8W, 1%, RN55C	
R48	200054–321	**Resistor**, 22.1kΩ, 1/8W, 1%, RN55C	
R49		(Same as R41)	
R50		(Same as R48)	
R51,52		(Same as R40)	
R53		(Same as R48)	
R54		(Same as R40)	
R55	200054–105	**Resistor**, 121Ω, 1/8W, 1%, RN55C	
R56		(Same as R1)	
R56–58		(Same as R40)	
R59		(Same as R48)	
R60		(Same as R40)	
R61		(Same as R48)	
R62–66		(Same as R40)	
R67		(Same as R41)	
R68		(Same as R1)	
R70		(Same as R3)	
R71–76		(Same as R40)	
R77		(Same as R55)	
R78–86		(Same as R40)	
R87,88	200054–139	**Resistor**, 274Ω, 1/8W, 1%, RN55C	
R89,90		(Same as R24)	
R91		(Same as R1)	
R92,93		(Same as R40)	
R94		(Same as R11)	
R95		(Same as R41)	
R96		(Same as R40)	
R97		(Same as R41)	
R98	201155–003	**Resistor**, 1000MΩ, 1W, 10%	

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5–3 Ref	Part Number	Description	Use Code	Qty
R99	200054–114	Resistor, 150Ω, 1/8W, 1%, RN55C		1
R100		(Same as R18)		
R101	200054–401	Resistor, 150kΩ, 1/8W, 1%, RN55C		1
R102		(Same as R18)		
R103,104		(Same as R11)		
R105		(Same as R18)		
R106	200054–165	Resistor, 511Ω, 1/8W, 1%, RN55C		1
R107,108		(Same as R41)		
R109		(Same as R24)		
R110		(Same as R41)		
R111		(Same as R24)		
R112		(Same as R12)		
R113–115		(Same as R11)		
R116,117		(Same as R18)		
R118		(Same as R37)		
R119	200054–143	Resistor, 301Ω, 1/8W, 1%, RN55C		1
R120		(Same as R41)		
R121		(Same as R45)		
R122	200054–469	Resistor, 768kΩ, 1/8W, 1%, RN55C		1
R123		(Same as R45)		
R124	200054–426	Resistor, 274kΩ, 1/8W, 1%, RN55C		1
R125		(Same as R106)		
R126,127		NOT INSTALLED		
R128	200054–334	Resistor, 30.1kΩ, 1/8W, 1%, RN55C		1
R129	200054–344	Resistor, 38.3kΩ, 1/8W, 1%, RN55C		1
R130		(Same as R18)		
R131,132	201155–000	Resistor, 500kΩ, 1W, 1%		2
R133		NOT INSTALLED		
R134–136	201969–313	Resistor, 51.1kΩ, 1/4W, 1%		3
R137,138	201969–361	Resistor, 5.11MΩ, 1/4W, 1%		2
R139	200054–508	Resistor, 2MΩ, 1/8W, 1%, RN55C		1
R140	200054–538	Resistor, 4.12MΩ, 1/8W, 1%, RN55C		1

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5–3 Ref	Part Number	Description	Use Code	Qty
R141,142		(Same as R3)		
R143	200054–395	**Resistor**, 130kΩ, 1/8W, 1%, RN55C		1
R144	200054–254	**Resistor**, 4.42kΩ, 1/8W, 1%, RN55C		1
R145	200054–575	**Resistor**, 10MΩ, 1/8W, 1%, RN55C		2
R146		(Same as R9)		
R147		(Same as R143)		
R148,149		(Same as R18)		
R150		(Same as R145)		
R151		(Same as R41)		
R152	200054–328	**Resistor**, 26.1kΩ, 1/8W, 1%, RN55C		1
R153,154		(Same as R145)		
R155	200054–392	**Resistor**, 121kΩ, 1/8W, 1%, RN55C		1
R156		(Same as R7)		
R157	200054–068	**Resistor**, 49.9Ω, 1/8W, 1%, RN55C		1
R158		(Same as R128)		
R159		(Same as R157)		
R160	200054–353	**Resistor**, 47.5kΩ, 1/8W, 1%, RN55C		1
R161	200054–267	**Resistor**, 6.04kΩ, 1/8W, 1%, RN55C		1
R162	200054–373	**Resistor**, 76.8kΩ, 1/8W, 1%, RN55C		1
R163	200054–402	**Resistor**, 154kΩ, 1/8W, 1%, RN55C		1
R164	200054–427	**Resistor**, 280kΩ, 1/8W, 1%, RN55C		1
R165		(Same as R145)		
R166		(Same as R164)		
R167		(Same as R11)		
R168	200054–387	**Resistor**, 107kΩ, 1/8W, 1%, RN55C		1
R169		(Same as R12)		
R170		(Same as R21)		
R171,172	200054–525	**Resistor**, 3.01MΩ, 1/8W, 1%, RN55C		2
R173		(Same as R40)		
R174,175		(Same as R18)		
R176	200527–012	Potentiometer, 50 kΩ, 1/2W, PCB		1
R177		(Same as R40)		

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5–3 Ref	Part Number	Description	Use Code	Qty
R178		(Same as R11)		
R179–183		(Same as R1)		
R184		(Same as R11)		
R185	200054–130	**Resistor**, 221Ω, 1/8W, 1%, RN55C		1
R186		(Same as R11)		
RN1	201425–018	**Resistor** Network, 4 x 20 kΩ, 1W, 1%		1
RN2	201425–004	**Resistor** Network, 4 x 20 kΩ, 1W, 1%		1
T1	803089–02	**Transformer**, isolation, 10kV, 290T–CT		1
U1	202052–000	IC, digital, HD63B03Y, microprocessor		1
U2	200669–002	IC, linear, LM339N, comparator		1
U3	804280–00	IC, digital, recorder gate array ⚠		1
U4	201703–000	IC, digital, 74HC4040, counter ⚠		1
U5	201126–000	IC, linear, 3525AN, pulse–width modulator		1
U6,7	201597–000	IC, linear, CNY65, opto–isolator		2
U9	803703–00	IC, digital, 12L6, programmable array logic		1
U10	202087–000	IC, digital, NCM031C, oscillator		1
U11,12	201511–001	IC, digital, 74HCT244, buffer ⚠		2
U13	202143–002	IC, digital, HM62256LP–12, static RAM, 32k x 8 ⚠		1
U14	803710–111	IC, digital, 27C256, programmed display EPROM ⚠		1
U15		(Same as U11)		
U16	201588–000	IC, digital, 74HC74, D–type flip–flop ⚠		1
U17	201608–001	IC, digital, 74HCT02, NOR gate ⚠		1
U18	201469–001	IC, digital, 74HCT00, NAND gate ⚠		2
U19,20	201638–001	IC, digital, 74HCT374, D–Type flip–flop ⚠		2
U21		(Same as U13)		
U22	803710–200	IC, digital, 27C256, EPROM , 32k x 8		1
U23	201705–000	IC, digital, 74HC14, inverter ⚠		1
U24		(Same as U18)		
U25	201609–001	IC, digital, 74HCT138, decoder ⚠		1
U26	201774–000	IC, digital, 74HC4538N, multivibrator ⚠		1

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5–3 Ref	Part Number	Description	Use Code	Qty
U27	803710–318	**IC**, digital, 27C256, programmed system EPROM ▲		
U28A,28B	202227–000	**IC**, digital, smartwatch RAM, 256k ▲		
U29	803720–00	**IC**, digital, display gate array ▲		
U30		(Same as U1)		
U31	201611–000	**IC**, digital, 74HC221, multivibrator ▲		
U32	201616–002	**IC**, digital, 74HC161, counter ▲		
U33	200165–000	**IC**, digital, 74C174N, D–type flip–flop ▲		
U34		(Same as U2)		
U35	202211–000	**IC**, linear, 33174, quad op amp		
U36	201641–000	**IC**, digital, 74HC76, J–K flip–flop ▲		
U37	200359–003	**IC**, linear, MC1404U5, voltage reference		
U38	200673–007	**IC**, linear, UA78L12ACLP, voltage regulator, 12V, TO–92		
U39	200706–053	**IC**, linear, 79L12, voltage regulator, –12V, TO–92		
U40		NOT INSTALLED		
U41,42	201743–001	**IC**, linear, DG509, multiplexer ▲		
U43	201342–070	**IC**, linear, analog switch, DG302 ▲		
U44,45	201214–002	**IC**, linear, LF444, quad op–amp		
U46	202156–000	**IC**, digital, DS1210, nonvolatile controller		
U47	200854–006	**IC**, linear, LM3342, adjustable current source, TO–92		
VSP1–3	200324–011	**Voltage Surge Protector,** 470V, 1pF		
VSP4	200324–016	**Voltage Surge Protector,** 8–10.3kV, 2pF		
VSP5,6		(Same as VSP1)		
XU1	202054–000	**Socket**, dip, 64 contact		
XU14,	200675–026	**Socket**, dip, 28 contact		
22,27,28		(Same as XU14)		
XU30		(Same as XU1)		
2	202245–001	**Rivnut**, dome head. 3/32 D x 0.187 L (used on P7)		
3	90–09138	**Wire**, AWG#22 (not shown, used on L2, L3)		

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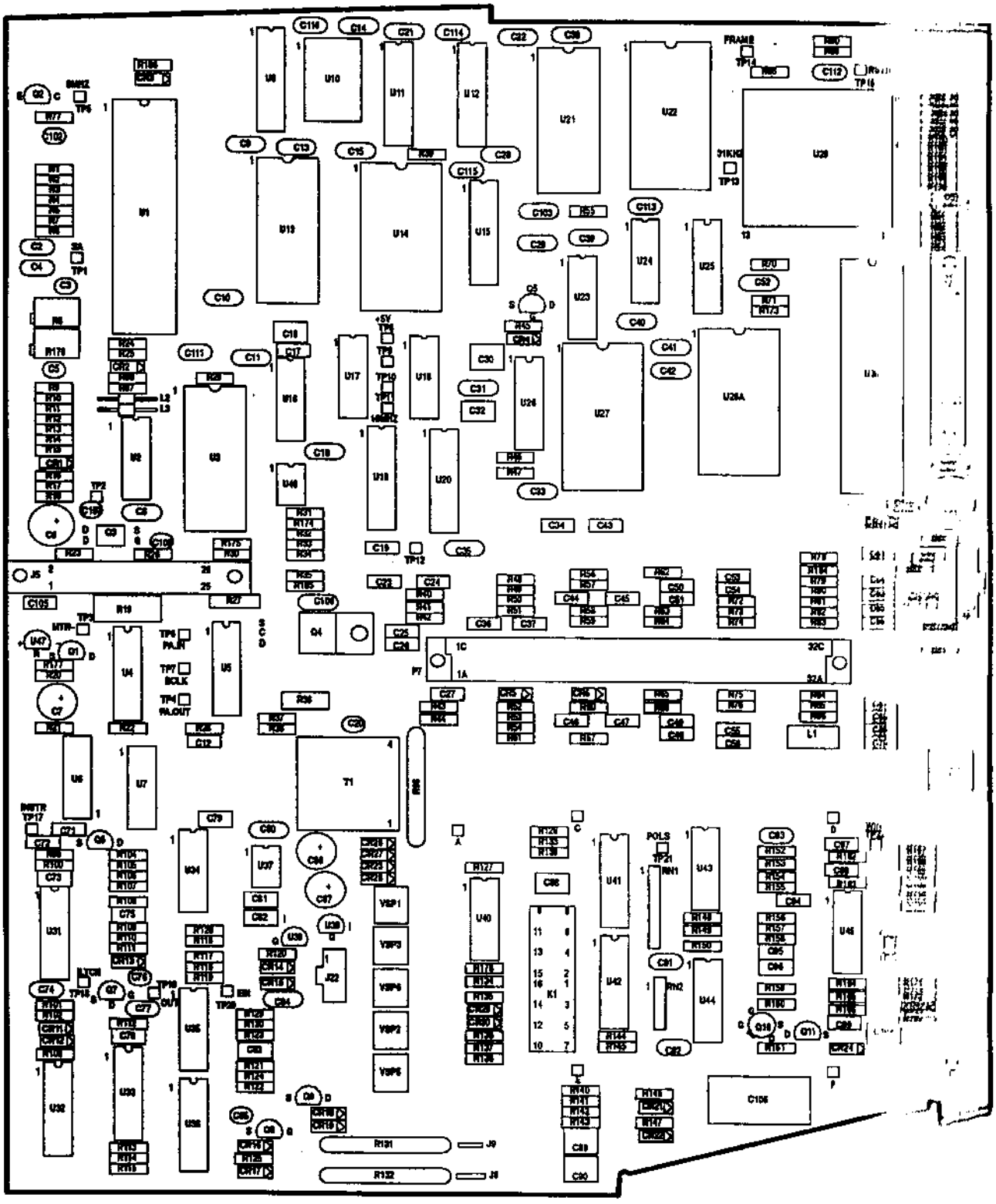

A1

Figure 5–3 Main PCB Assembly
Part Number 803715–11
(Sheet 1 of 5)

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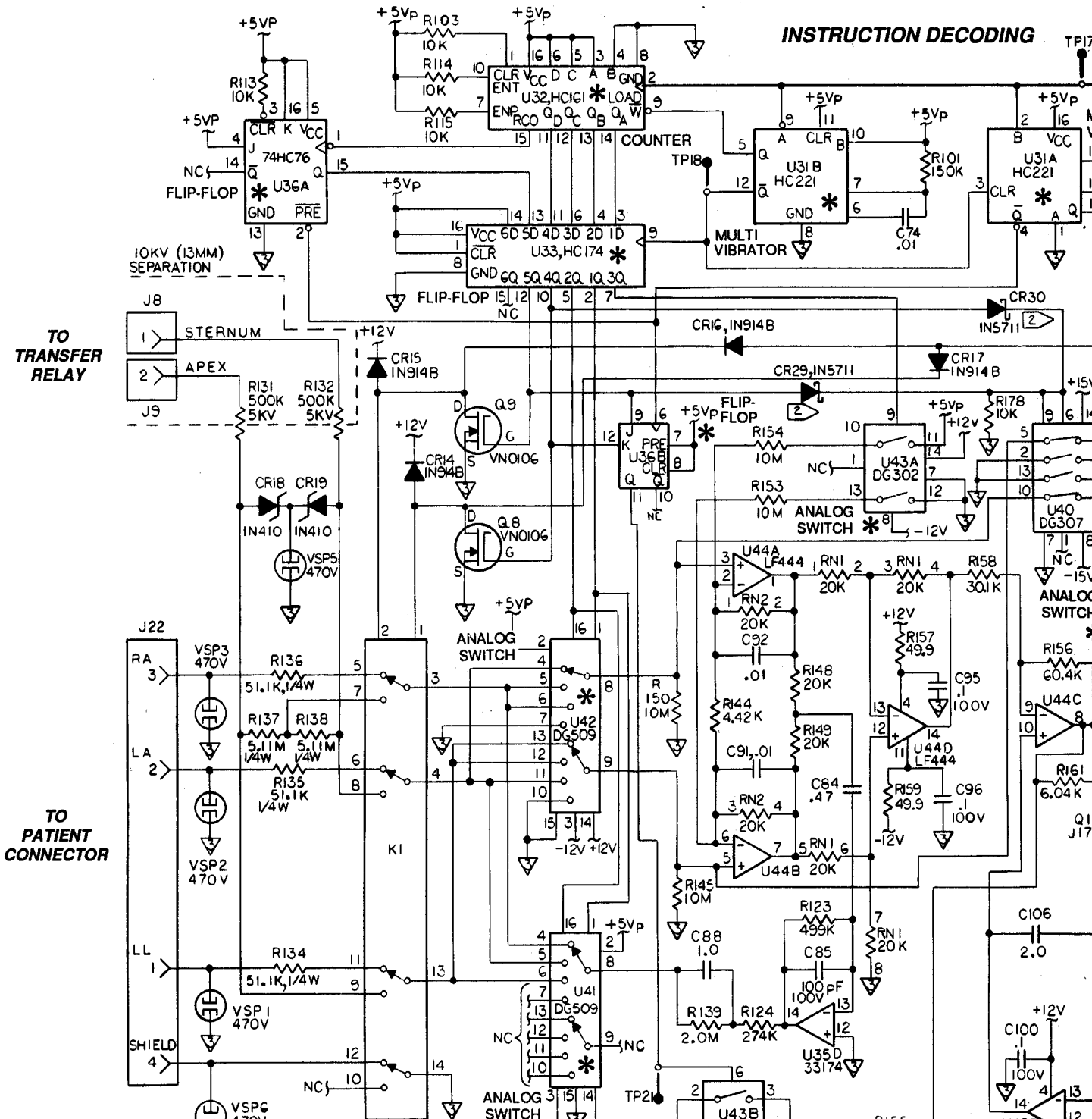
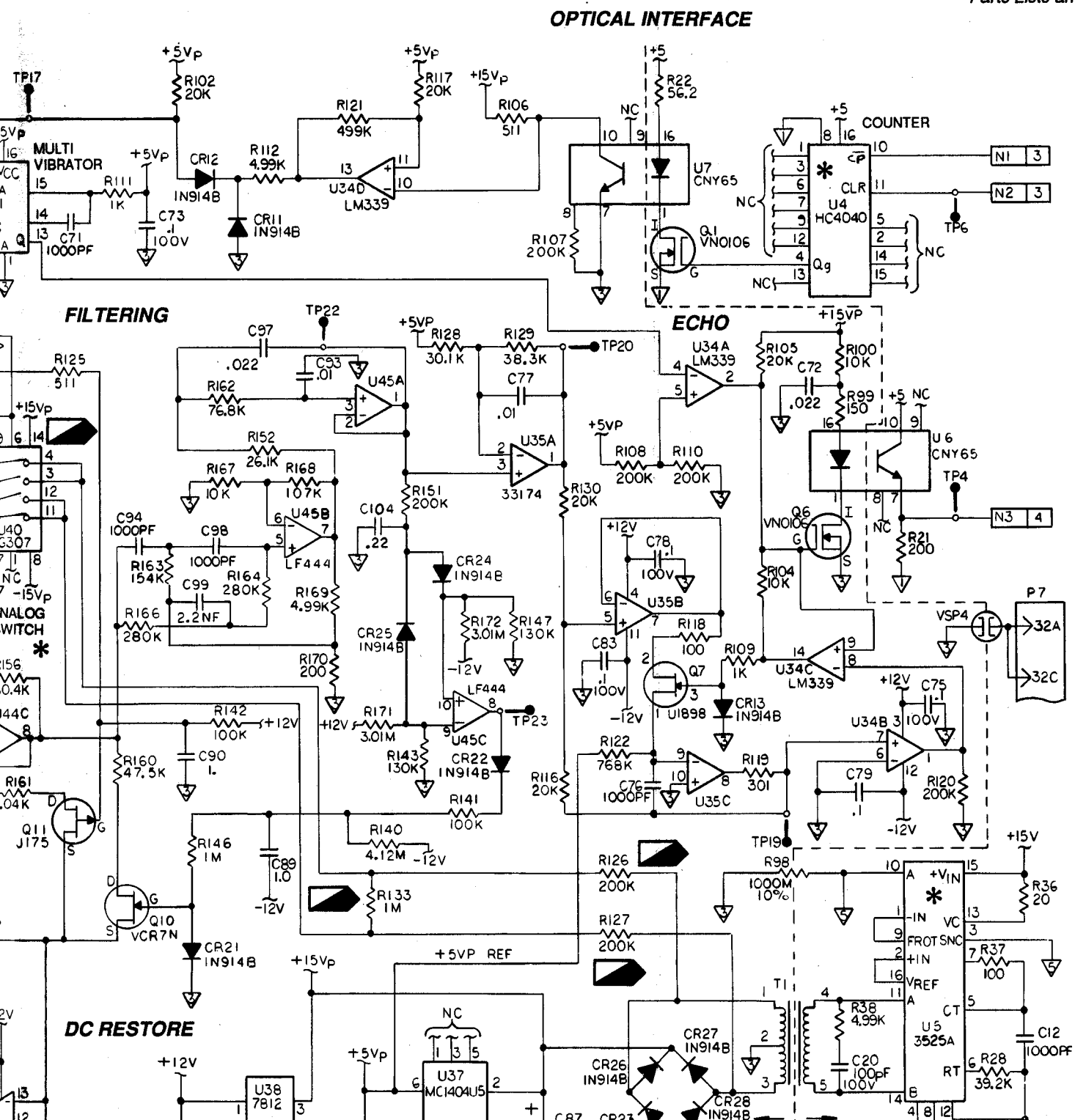
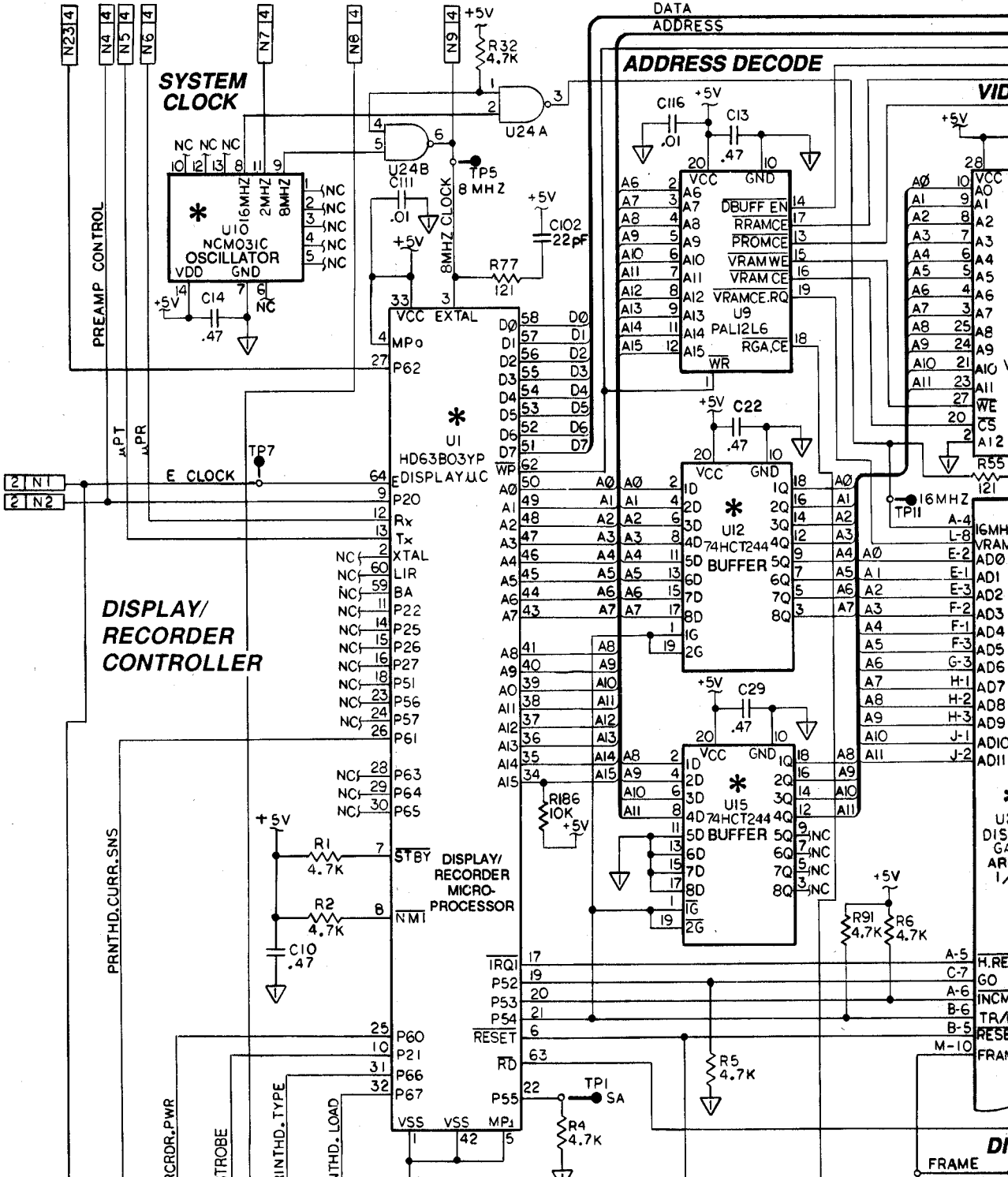
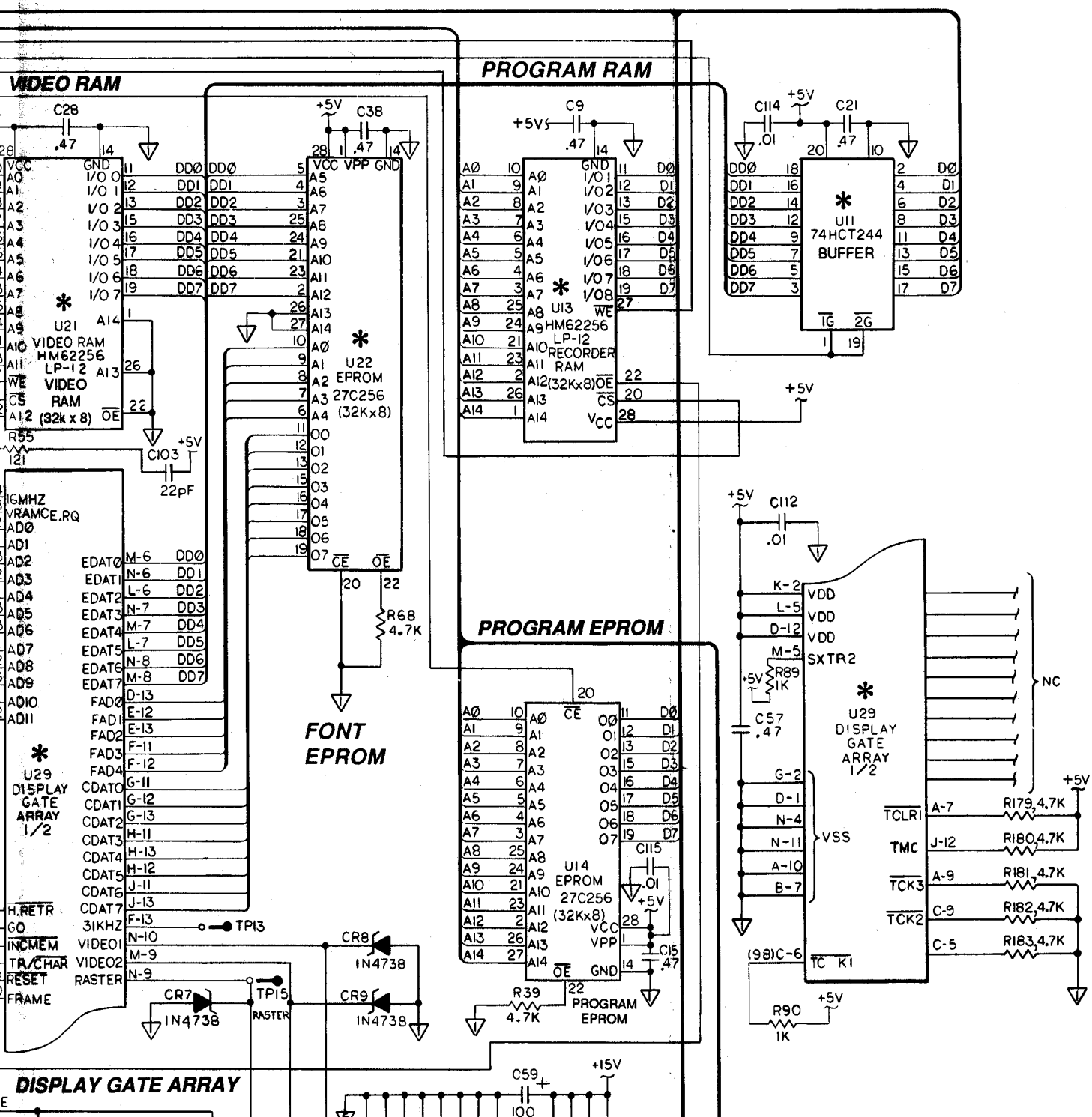
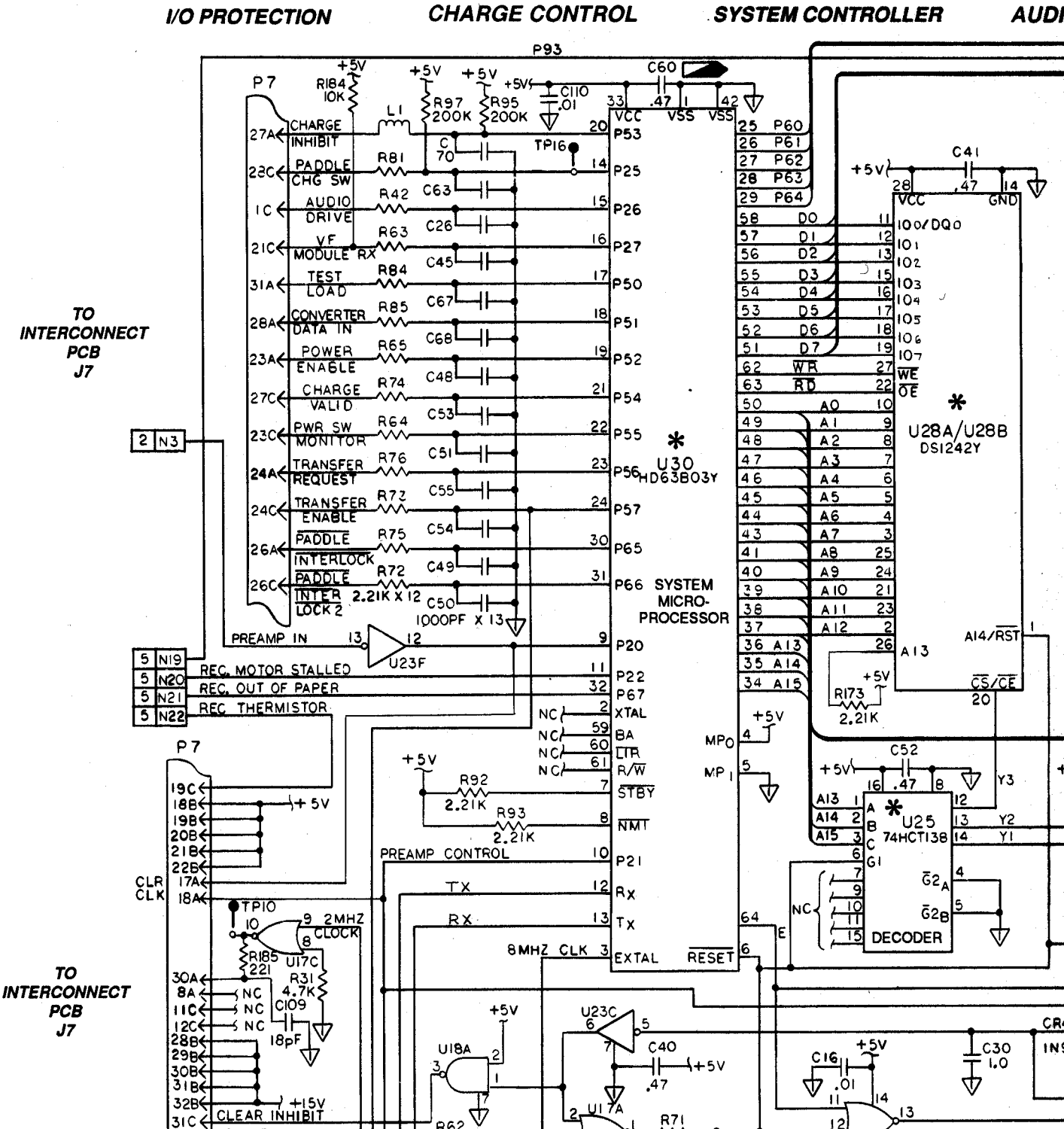
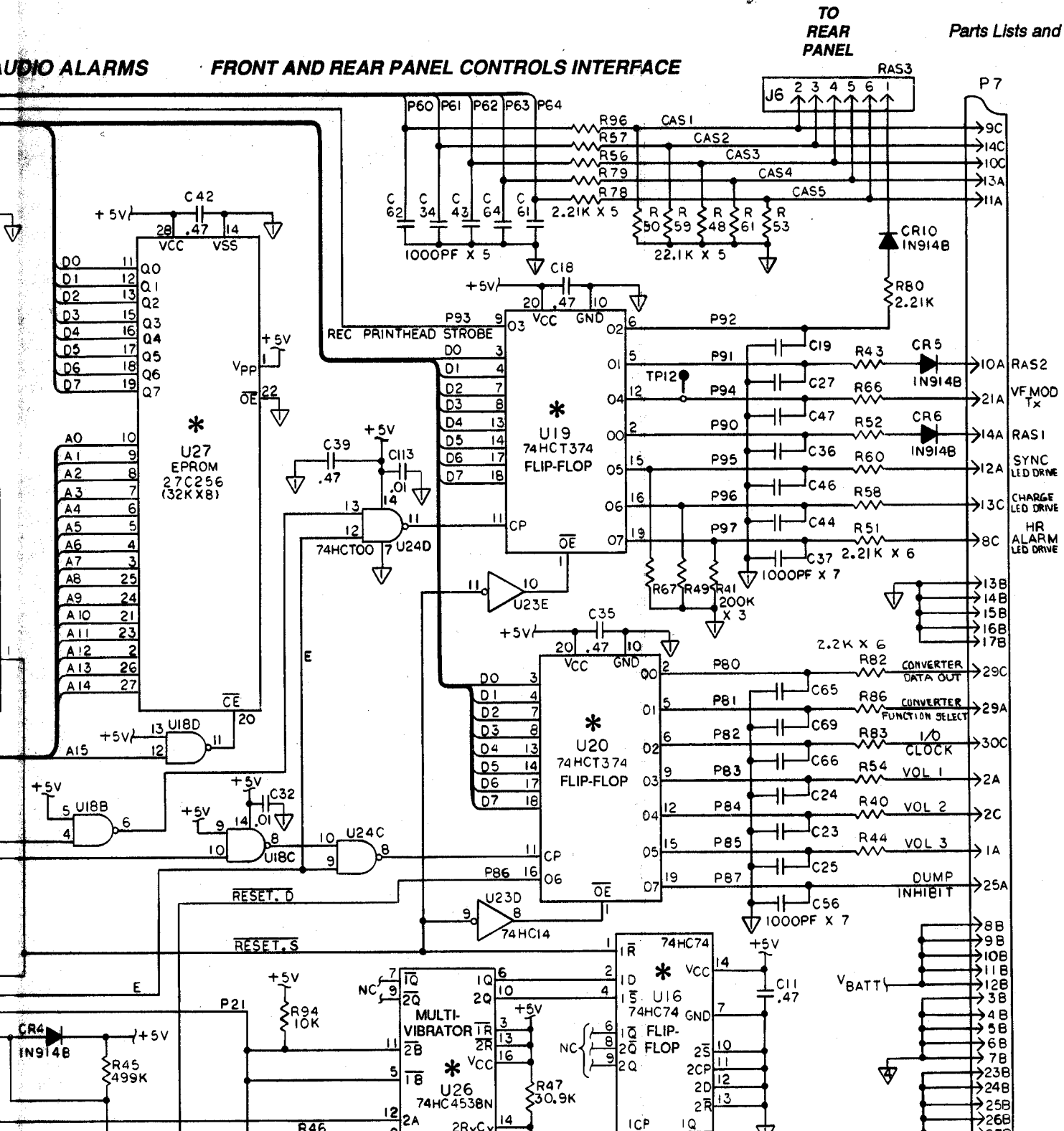

INSTRUCTION DECODING
TO TRANSFER RELAY
TO PATIENT CONNECTOR
J8
STERNUM
APEX
J9
J22
RA
LA
LL
SHIELD
10KV (13MM) SEPARATION
+5VP
+12V
-12V
-15V
R103 10K
R114 10K
R115 10K
R113 10K
U32,HC161
COUNTER
74HC76
FLIP-FLOP
U36A
U33,HC174
MULTI VIBRATOR
U31B HC221
U31A HC221
R101 150K
C74 .01
TP18
TP17
CR30 IN5711
CR16,IN914B
CR17 IN914B
CR29,IN5711
CR15 IN914B
CR14 IN914B
CR18 CR19 IN410 IN410
VSP5 470V
VSP3 470V
VSP2 470V
VSP1 470V
R131 500K 5KV
R132 500K 5KV
Q9 VN0106
Q8 VN0106
R136 51.1K,1/4W
R137 5.11M 1/4W
R138 5.11M 1/4W
R135 51.1K 1/4W
R134 51.1K,1/4W
K1
U42 DG509
U41 DG509
ANALOG SWITCH
U43A DG302
U43B
U40 DG307
R154 10M
R153 10M
R178 10K
U44A LF444
U44B
U44C
U44D LF444
RN1 20K
RN2 20K
R158 30.1K
R156 60.4K
R161 6.04K
C92 .01
R148 20K
R144 4.42K
R149 20K
C91,.01
C84 .47
R157 49.9
C95 .1 100V
R159 49.9
C96 .1 100V
R150 10M
R145 10M
C88 1.0
R123 499K
C85 100 pF 100V
R139 2.0M
R124 274K
U35D 33174
C106 2.0
C100 .1 100V
TP21
NC

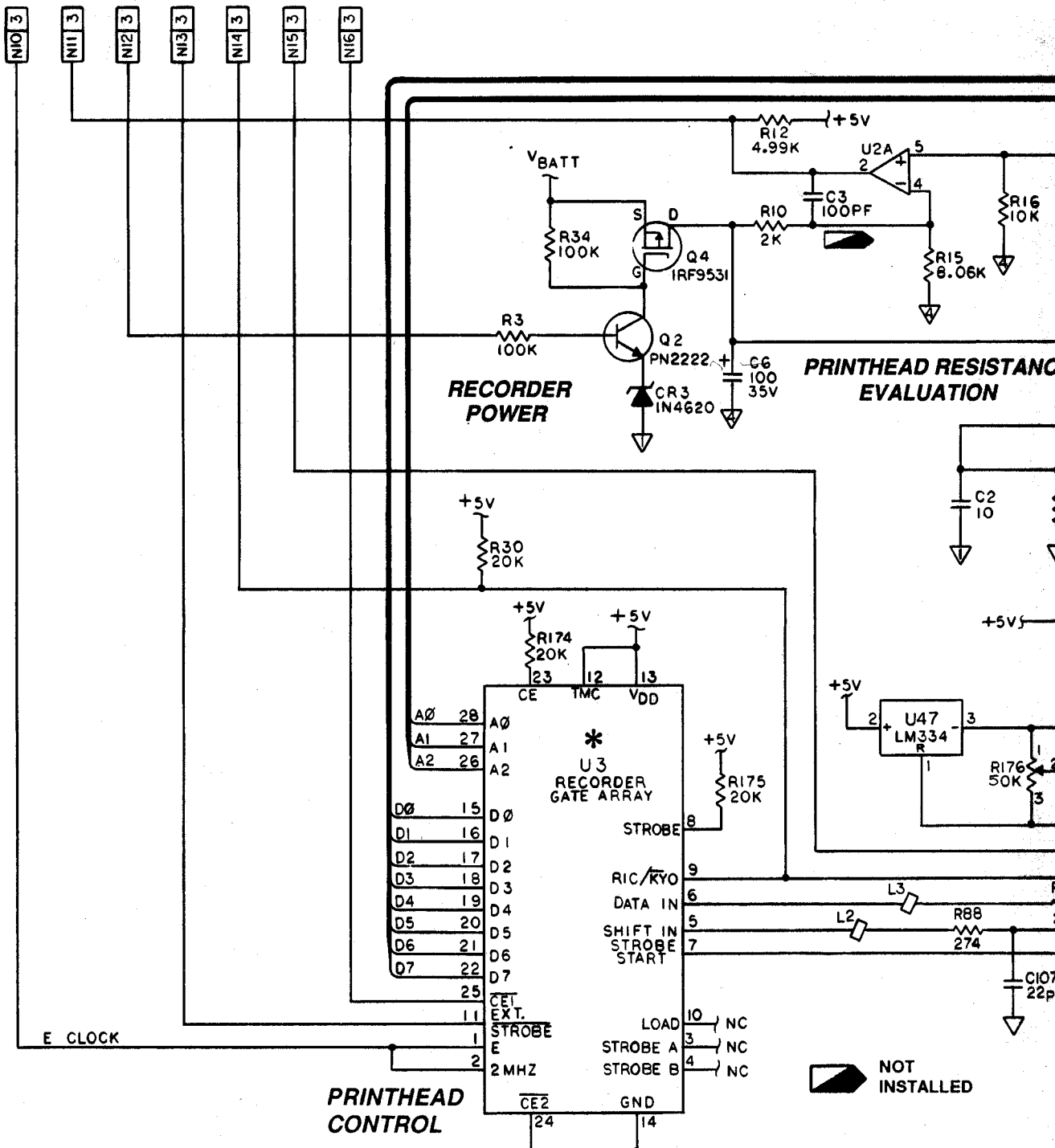

OPTICAL INTERFACE
FILTERING
ECHO
DC RESTORE
MULTI VIBRATOR
COUNTER
U4 HC4040
U7 CNY65
U6 CNY65
Q1 VN0106
Q6 VN0106
U45A
U45B
U45C
U34A LM339
U34B
U34C LM339
U35A
U35B
U35C
LF444
33174
U5 3525A
U37 MC1404U5
U38 7812
Q10 VCR7N
Q11 J175
Q7 U1898
T1
P7
TO INTERCON PCB J7
+5VP
+15VP
-15VP
+12V
-12V
+5VP REF
TP17
TP19
TP20
TP22
TP23
TP4
TP6

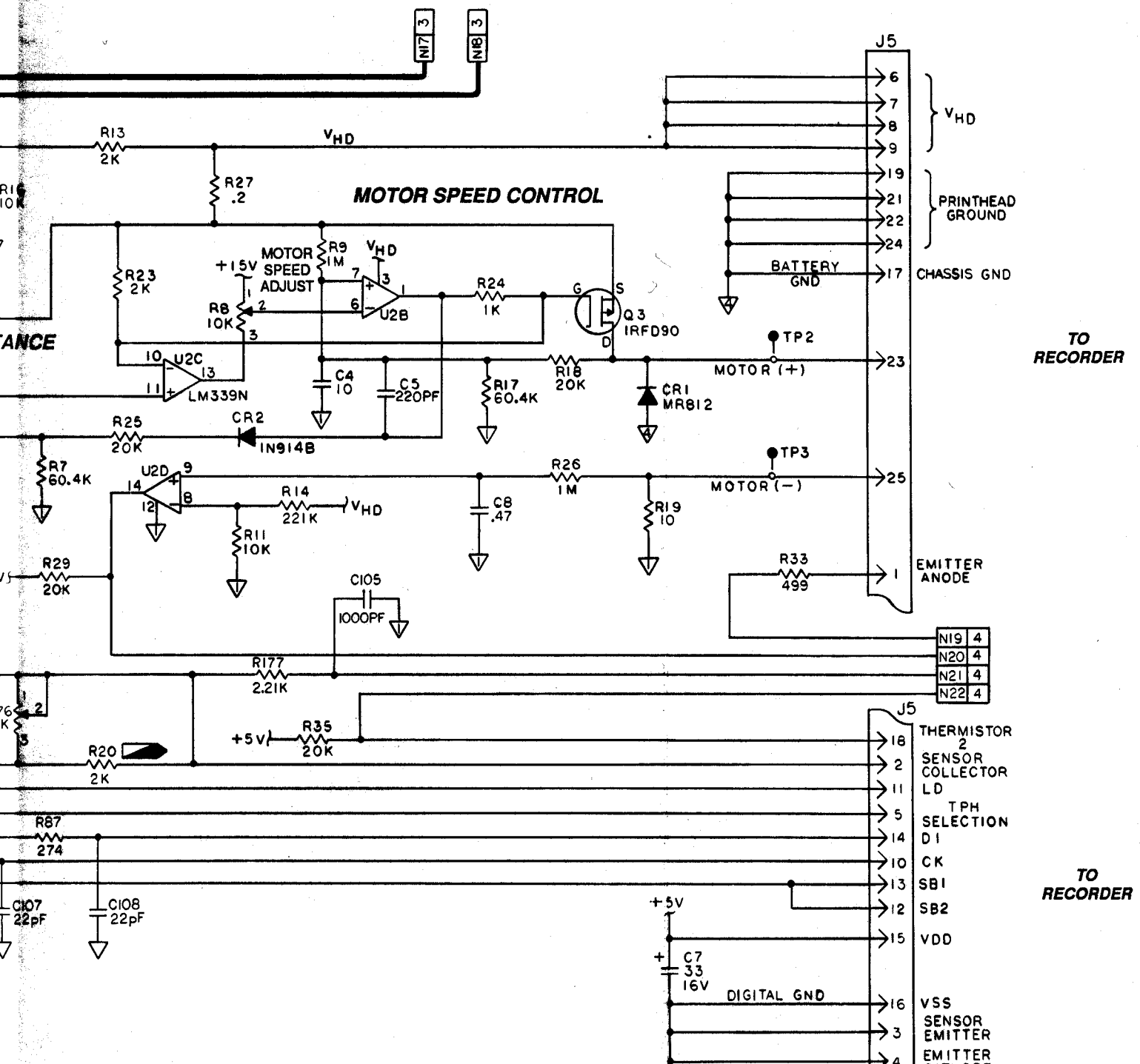

SYSTEM CLOCK
DISPLAY/ RECORDER CONTROLLER
ADDRESS DECODE
DATA
ADDRESS
PREAMP CONTROL
U10 NCM031C OSCILLATOR
U1 HD63B03YP DISPLAY µC
DISPLAY/ RECORDER MICRO-PROCESSOR
U24A
U24B
U9 PAL12L6
U12 74HCT244 BUFFER
U15 74HCT244 BUFFER
8MHZ CLOCK
E CLOCK
PRNTHD.CURR.SNS
+5V
TP5 8 MHZ
TP7
TP11 16MHZ
TP1 SA


VIDEO RAM
PROGRAM RAM
PROGRAM EPROM
FONT EPROM
DISPLAY GATE ARRAY
U21 VIDEO RAM HM62256 LP-12 VIDEO RAM (32k x 8)
U22 EPROM 27C256 (32Kx8)
U13 HM62256 LP-12 RECORDER RAM (32Kx8)
U11 74HCT244 BUFFER
U14 EPROM 27C256 (32Kx8)
U29 DISPLAY GATE ARRAY 1/2
PROGRAM EPROM
16MHZ
VRAMCE.RQ
H.RETR
GO
INCMEM
TR/CHAR
RESET
FRAME
31KHZ
VIDEO1
VIDEO2
RASTER
TCLR1
TMC
TCK3
TCK2
TC
K1
VDD
VSS
SXTR2
NC
+5V
+15V
C28
C38
C9
C114
C21
C112
C103
C57
C59
C115
R55
R68 4.7K
R39 4.7K
R89 1K
R90 1K
R179 4.7K
R180 4.7K
R181 4.7K
R182 4.7K
R183 4.7K
CR7 IN4738
CR8 IN4738
CR9 IN4738
TP13
TP15
22pF
.47
.01
100


I/O PROTECTION
CHARGE CONTROL
SYSTEM CONTROLLER
AUDI
TO INTERCONNECT PCB J7
TO INTERCONNECT PCB J7
P93
P7
CHARGE INHIBIT
PADDLE CHG SW
AUDIO DRIVE
VF MODULE RX
TEST LOAD
CONVERTER DATA IN
POWER ENABLE
CHARGE VALID
PWR SW MONITOR
TRANSFER REQUEST
TRANSFER ENABLE
PADDLE INTERLOCK
PADDLE INTER LOCK 2
2.21K X 12
1000PF X 13
PREAMP IN
U23F
REC. MOTOR STALLED
REC. OUT OF PAPER
REC. THERMISTOR
U30
HD63B03Y
SYSTEM MICRO-PROCESSOR
U28A/U28B
DS1242Y
U25
74HCT138
DECODER
PREAMP CONTROL
TX
RX
8MHZ CLK
EXTAL
RESET
XTAL
CLR
CLK
TP10
2MHZ CLOCK
CLEAR INHIBIT
+15V
+5V
U18A
U23C
U17A
C40
C16
C30
R71
R62
R31
C109
18pF
R185
R92
R93
C52
C41
R173
2.21K


AUDIO ALARMS
FRONT AND REAR PANEL CONTROLS INTERFACE
TO REAR PANEL
RAS3
J6 2 3 4 5 6 1
P7
P60 P61 P62 P63 P64
R96 CAS1
R57 CAS2
R56 CAS3
R79 CAS4
R78 CAS5
C 62 C 34 C 43 C 64 C 61
1000PF X 5
2.21K X 5
R 50 R 59 R 48 R 61 R 53
22.1K X 5
CR10 IN914B
R80 2.21K
C42
+5V
28 .47 14
VCC VSS
D0 D1 D2 D3 D4 D5 D6 D7
Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14
U27
EPROM
27C256
(32K X 8)
VPP
OE
CE
A15
C18
20 .47 10
VCC GND
REC PRINTHEAD STROBE
P93
P92
U19
74HCT374
FLIP-FLOP
CP
OE
P91 P94 P90 P95 P96 P97
C19 C27 C47 C36 C46 C44 C37
TP12
R43 R66 R52 R60 R58 R51
2.21K X 6
1000PF X 7
CR5 IN914B
CR6 IN914B
10A RAS2
21A VF MOD Tx
14A RAS1
12A SYNC LED DRIVE
13C CHARGE LED DRIVE
8C HR ALARM LED DRIVE
R67 R49 R41 200K X 3
U23E
C39 .47
C113 .01
74HCT00 U24D
U18D
U18B
U18C
C32 .01
U24C
C35
U20
74HCT374
FLIP-FLOP
P80 P81 P82 P83 P84 P85 P86 P87
R82 CONVERTER DATA OUT
R86 CONVERTER FUNCTION SELECT
R83 I/O CLOCK
R54 VOL 1
R40 VOL 2
R44 VOL 3
C65 C69 C66 C24 C23 C25 C56
2.2K X 6
29C
29A
30C
2A
2C
1A
25A
1000PF X 7
DUMP INHIBIT
13B 14B 15B 16B 17B
8B 9B 10B 11B 12B 3B 4B 5B 6B 7B 23B 24B 25B 26B
TO INTERCOM PCB J7
RESET.D
RESET.S
U23D
74HC14
E
P21
R94 10K
CR4 IN914B
R45 499K
MULTI-VIBRATOR
U26
74HC4538N
R47 30.9K
74HC74
U16
74HC74
FLIP-FLOP
C11 .47
VBATT


N10 3
N11 3
N12 3
N13 3
N14 3
N15 3
N16 3
+5V
R12
4.99K
U2A
VBATT
C3
100PF
R16
10K
R34
100K
Q4
IRF9531
R10
2K
R15
8.06K
R3
100K
Q2
PN2222
C6
100
35V
CR3
IN4620
RECORDER
POWER
PRINTHEAD RESISTANC
EVALUATION
C2
10
R30
20K
R174
20K
CE
TMC
VDD
U3
RECORDER
GATE ARRAY
R175
20K
STROBE
RIC/KYO
DATA IN
SHIFT IN
STROBE
START
U47
LM334
R176
50K
L3
L2
R88
274
C107
22p
E CLOCK
2MHZ
LOAD
STROBE A
STROBE B
NC
GND
PRINTHEAD
CONTROL
NOT
INSTALLED


N17 3
N18 3
J5
6
7
8
9
V_{HD}
19
21
22
24
PRINTHEAD GROUND
BATTERY GND
17
CHASSIS GND
R13 2K
V_{HD}
R27 .2
MOTOR SPEED CONTROL
+15V
MOTOR SPEED ADJUST
R9 1M
V_{HD}
R8 10K
U2B
R24 1K
G
S
Q3 IRFD90
D
TP2
MOTOR (+)
23
TO RECORDER
R23 2K
U2C
LM339N
C4 10
C5 220PF
R17 60.4K
R18 20K
CR1 MR812
R25 20K
CR2 IN914B
R7 60.4K
U2D
R14 221K
V_{HD}
R11 10K
R26 1M
C8 .47
R19 10
TP3
MOTOR (-)
25
R29 20K
C105 1000PF
R33 499
1
EMITTER ANODE
N19 4
N20 4
N21 4
N22 4
R177 2.21K
J5
+5V
R35 20K
R20 2K
18
THERMISTOR 2
2
SENSOR COLLECTOR
11
LD
5
TPH SELECTION
14
D1
10
CK
13
SB1
12
SB2
TO RECORDER
R87 274
C107 22pF
C108 22pF
+5V
15
VDD
C7 33 16V
DIGITAL GND
16
VSS
3
SENSOR EMITTER
4
EMITTER

5–4 Ref	Part Number	Description	User Code	Qty REF
A2	**803726–01**	**Power Supply PCB Assembly**		
C1	BOS240005–221	**Capacitor**, 220pF/250V, 20%		
C2	BOS220073–473	**Capacitor**, 0.047µF/250V, 20%		
C3	BOS200113–227	**Capacitor**, 200µF/400V		
C4	BOS230001–473	**Capacitor**, 0.047µF/630V		
C5	BOS220019–681	**Capacitor**, 680pF/1.5kV, 10%		
C6	BOS210031–336	**Capacitor**, 33µF/50V		
C7	BOS240011–221	**Capacitor**, 220pF/50V, 10%		
C8	BOS220010–104	**Capacitor**, 0.1µF/63V, 5%		
C10–13	BOS210046–108	**Capacitor**, 1000µF/35V		
C14	BOS220071–105	**Capacitor**, 1µF/63V, 10%		
C15		(Same as C8)		
C18		(Same as C8)		
C19	BOS220041–332	**Capacitor**, 3300pF/100V, 5%		
C20	BOS220011–224	**Capacitor**, 0.22µF/63V, 5%		
C21,22		(Same as C1)		
C23	BOS220075–334	**Capacitor**, 0.33µF/250V, 20%		
CR1	BOS100006–600	**Diode**, bridge, 600V, 4A		
CR2	BOS100014–600	**Diode**, BYV26C, 600V, 1A		
CR3	BOS100015–600	**Diode**, 1N4937, 600V, 1A		
CR4	BOS110005–015	**Diode**, Zener, 1N4744A, 15V/17mA, 1W, 5%		
CR5–8	BOS100065–075	**Diode**, 1N4448, 0.2W		
CR10	BOS100038–200	**Diode**, BYV72–200, 200V, 30A		
CR11	BOS100049–045	**Diode**, 45V, 16A		
CR12	BOS150002–100	**Diode**, MCR72–3, 100V, 8A		
CR13	BOS110005–020	**Diode**, Zener, 1N4747A, 20V, 1W, 5%		
CR14–16		(Same as CR5)		
J1	BOS450089–06	**Connector**, locking, 6 contact		
J2	BOS450089–12	**Connector**, locking, 12 contact		
JP1–3	BOS430064–22	**Wire**, bus, 22 AWG		
L1	BOS800279	**Inductor**, balanced		
L2	BOS800280	**Inductor**, common mode		
Q1	BOS130092	**Transistor**, HEXFET, IRF840, N–channel		

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5–4 Ref	Part Number	Description	Use Code	Qty
Q2	BOS130060	Transistor, NPN, ZTX649, TO–92		1
Q3	BOS130080	Transistor, FET, 2N7000, N–channel		1
Q4	BOS120024	Transistor, PNP, MPS4250, TO–92		1
R1	BOS300040–105	Resistor, 1 MΩ, 1/2W, 5%		1
R2	BOS300020–182	Resistor, 1.8kΩ, 1/4W, 5%		1
R3	BOS300040–471	Resistor, 470Ω, 1/2W, 5%		1
R4	BOS300020–393	Resistor, 39kΩ, 1/4W, 5%		1
R5	BOS300020–750	Resistor, 75Ω, 1/4W, 5%		2
R6	BOS300020–4.7	Resistor, 4.7Ω, 1/4W, 5%		1
R7	BOS300020–102	Resistor, 1kΩ, 1/4W, 5%		3
R8	BOS320010–7680	Resistor, 768Ω, 1/4W, 1%		1
R9, 10	BOS300020–130	Resistor, 13Ω, 1/4W, 5%		2
R11, 12	BOS330020–.15	Resistor, 0.15Ω, 1W, 5%		2
R13	BOS330031–331	Resistor, 330Ω, 1/4W, 5%		1
R14	BOS330031–472	Resistor, 4.7kΩ, 5W, 5%		1
R15		(Same as R5)		
R16	BOS330031–151	Resistor, 150Ω, 5W, 5%		1
R17	BOS300020–330	Resistor, 33Ω, 1/4W, 5%		1
R18	BOS300020–100	Resistor, 10Ω, 1/4W, 5%		1
R19	BOS300020–103	Resistor, 10kΩ, 1/4W, 5%		1
R20	BOS300040–151	Resistor, 150Ω, 1/2W, 5%		1
R21	BOS320010–6341	Resistor, 6.34kΩ, 1/4W, 1%		1
R22	BOS320010–6490	Resistor, 649Ω, 1/4W, 1%		1
R23	BOS380002–201	Potentiometer, 200Ω		1
R24		(Same as R7)		
R25	BOS300020–682	Resistor, 6.8kΩ, 1/4W, 5%		1
R26	BOS300040–751	Resistor, 750Ω, 1/2W, 5%		2
R27, 28	BOS300020–332	Resistor, 3.3kΩ, 1/4W, 5%		2
R29		(Same as R26)		
R30		(Same as R7)		
R31	BOS300020–560	Resistor, 56Ω, 1/4W, 5%		1
R32	BOS300020–752	Resistor, 7.5kΩ, 1/4W, 5%		1
R33	BOS300020–622	Resistor, 6.2kΩ, 1/4W, 5%		1
RT1	BOS390013	Thermistor, 10Ω, 4A, 15%		1
RT2	BOS390002	Thermistor, 220Ω, 5%		1
RV1	BOS390020	Varistor, 75J, 387Vmin		1

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5–4 Ref	Part Number	Description	Use Code	Qty
T1	BOS800278	**Transformer**, UL544/VDE		1
T2	BOS800056	**Transformer**, pulse		1
VR1	BOS140017	**IC**, linear, TL431, adjustable shunt regulator		1
2	BOS640007	**Adhesive**, RTV		AR
3	BOS500319	**Cover** (not shown)		1
4	BOS500318	**Heat Sink**, diode		1
5	BOS500133	**Heat Sink**, transistor		1
6	BOS520058	**Insulator** (not shown, used on Q1, CR10–12)		4
7	BOS530008	**Label**, model number (not shown, used on C3)		1
8	BOS530072	**Label**, serial number (not shown, used on item 5)		1
9	BOS600006–0375	**Screw**, pan head, 8–32 x 0.375 L (not shown, used on item 3)		4
10	BOS610011	**Spacer**, glass, 0.220 x 0.062		3
11	BOS500062	**Spring Clip** (used on Q1, CR10 to 12)		4
12	BOS610059–2200	**Standoff**		1
13	BOS840021	**Tape**, 0.0625 x 0.500 L (not shown, used on L2)		AR
14	BOS600067	**Washer**, flat, #8 (not shown, used on item 3)		4
15	BOS600083	**Washer**, lock, #8 (not shown, used on item 3)		4

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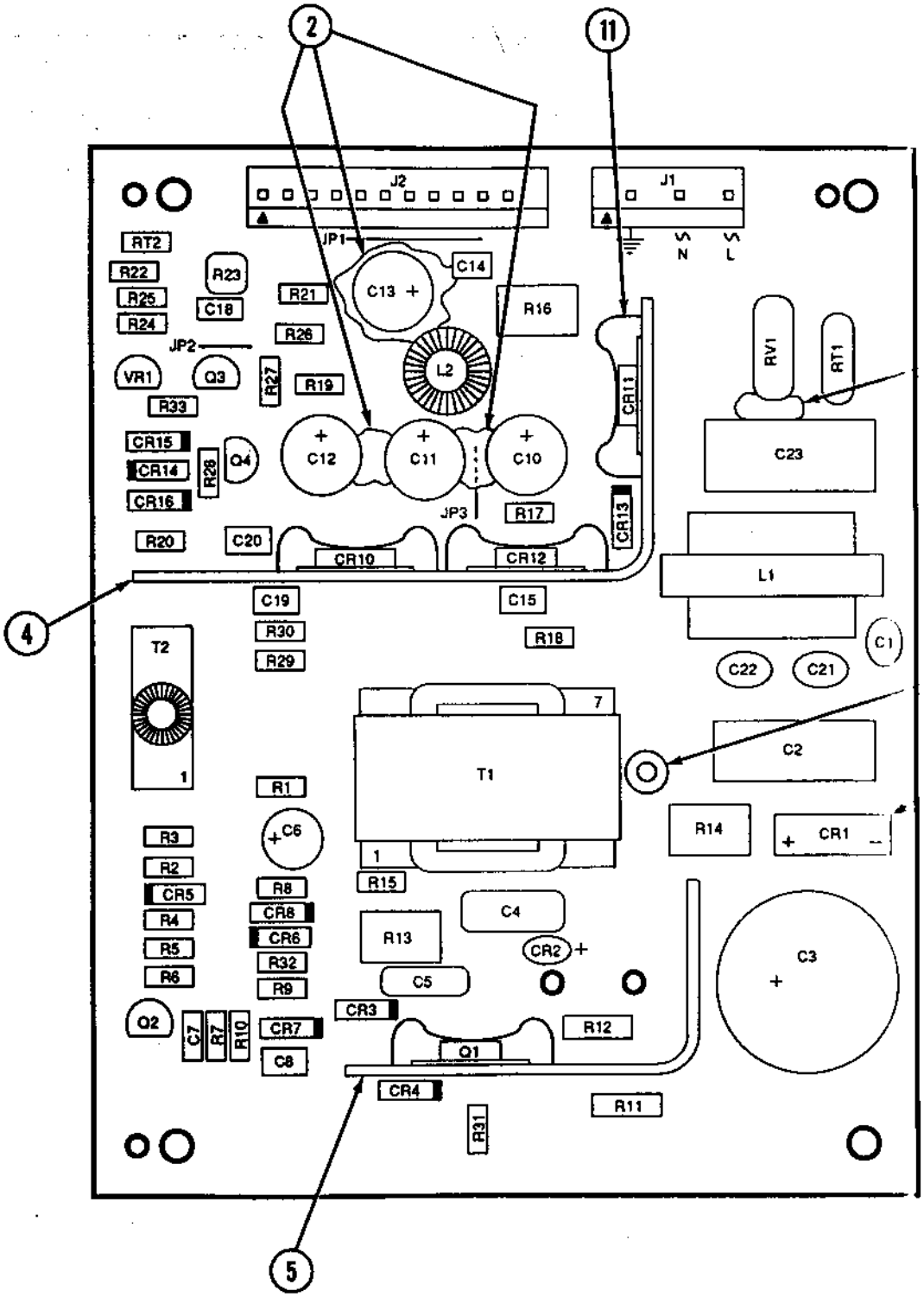

A2

Figure 5–4 Power Supply Assembly
Part Number 803726–01
(Sheet 1 of 2)

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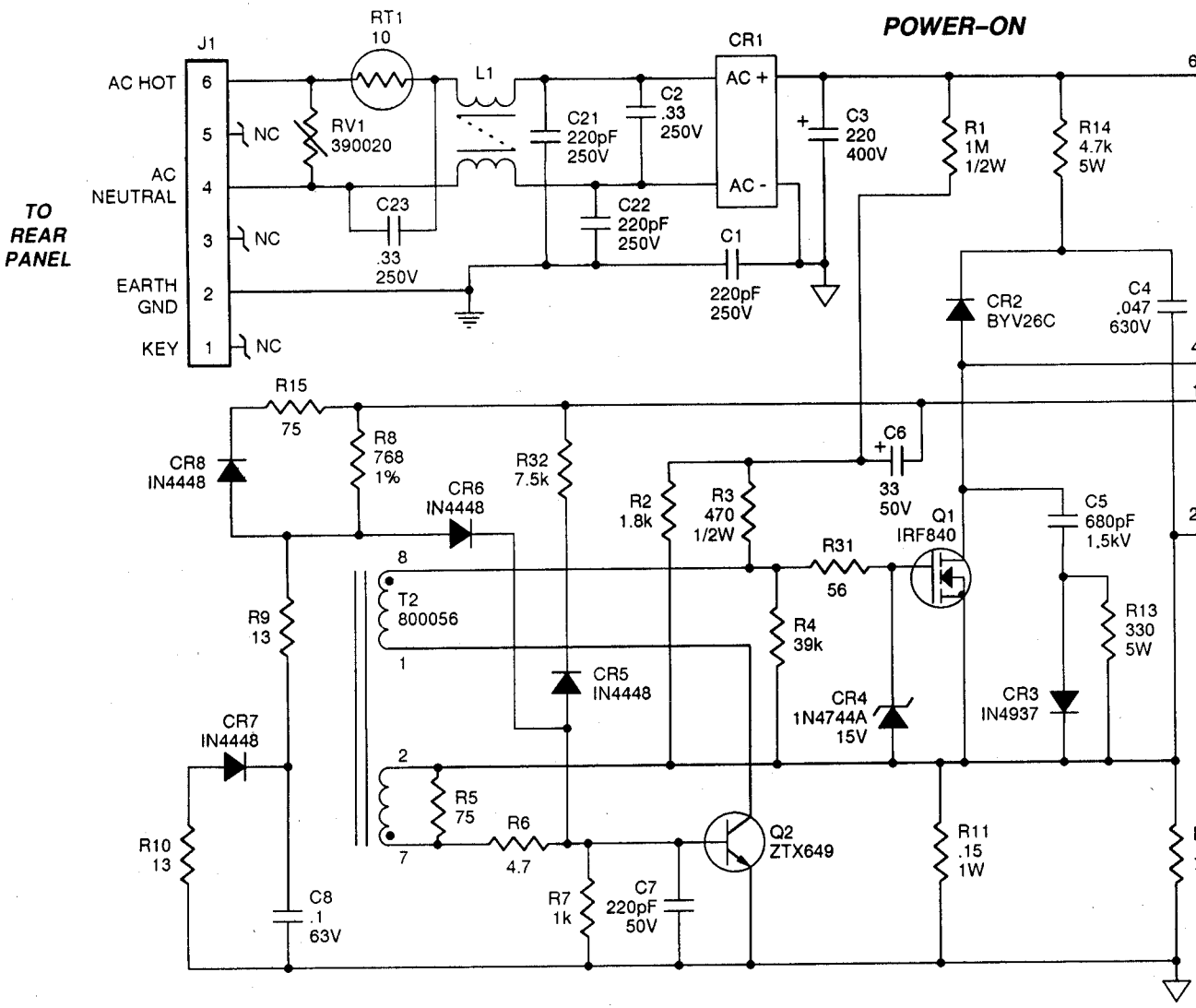
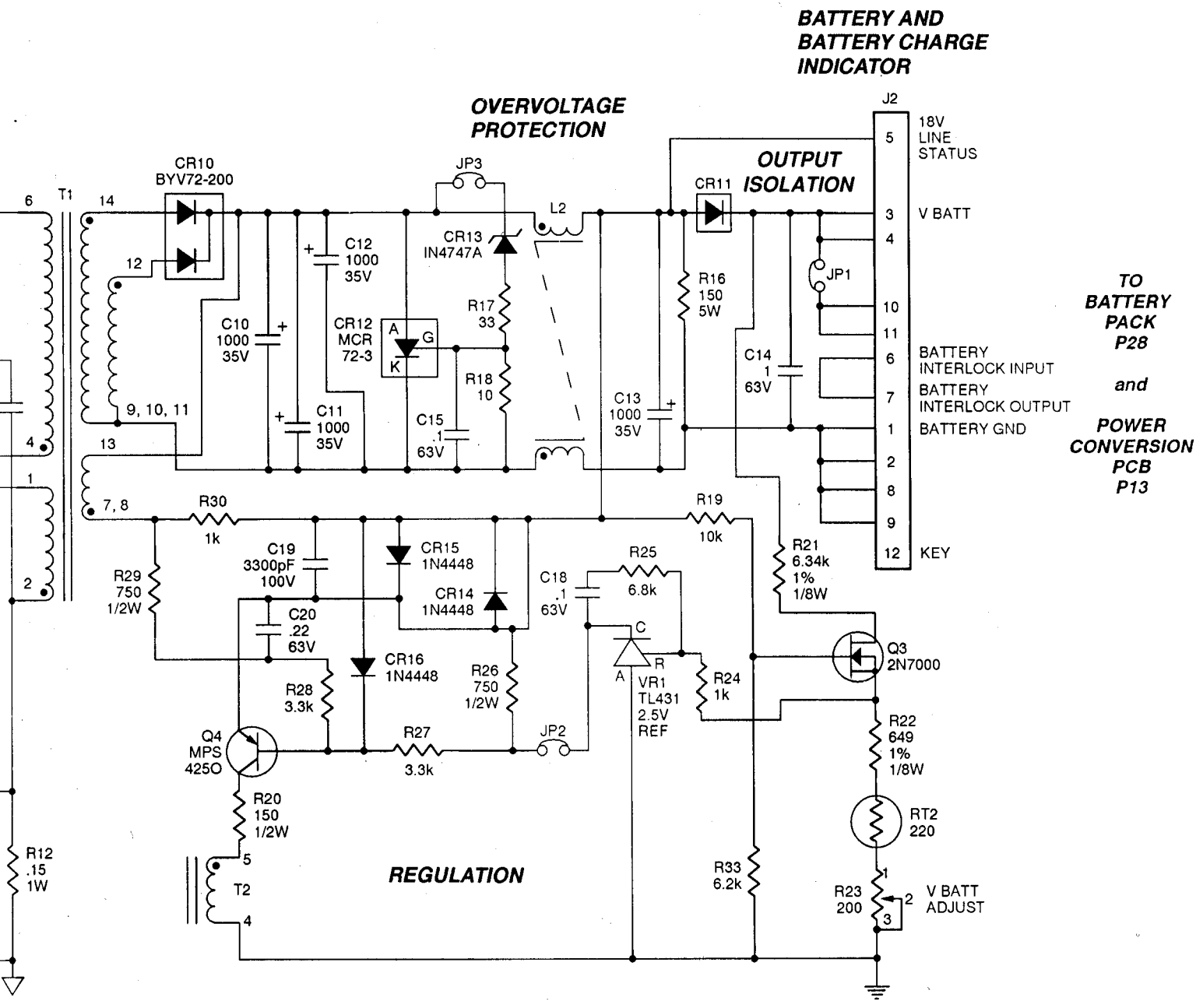

POWER-ON
TO REAR PANEL
J1
AC HOT
AC NEUTRAL
EARTH GND
KEY
NC
RT1
10
RV1
390020
L1
C21
220pF
250V
C2
.33
250V
C22
220pF
250V
C23
.33
250V
C1
220pF
250V
CR1
AC +
AC -
C3
220
400V
R1
1M
1/2W
R14
4.7k
5W
CR2
BYV26C
C4
.047
630V
R15
75
R8
768
1%
CR8
IN4448
CR6
IN4448
R32
7.5k
R2
1.8k
R3
470
1/2W
C6
33
50V
Q1
IRF840
R31
56
C5
680pF
1.5kV
T2
800056
R9
13
R4
39k
R13
330
5W
CR5
IN4448
CR4
1N4744A
15V
CR3
IN4937
CR7
IN4448
R5
75
R6
4.7
Q2
ZTX649
R11
.15
1W
R10
13
C8
.1
63V
R7
1k
C7
220pF
50V


BATTERY AND
BATTERY CHARGE
INDICATOR
OVERVOLTAGE
PROTECTION
OUTPUT
ISOLATION
REGULATION
J2
5 18V LINE STATUS
3 V BATT
4
10
11
6 BATTERY INTERLOCK INPUT
7 BATTERY INTERLOCK OUTPUT
1 BATTERY GND
2
8
9
12 KEY
TO BATTERY PACK P28
and
POWER CONVERSION PCB P13
T1
6
4
1
2
14
12
9, 10, 11
13
7, 8
CR10 BYV72-200
C10 1000 35V
C11 1000 35V
C12 1000 35V
CR12 MCR 72-3
A
G
K
JP3
CR13 IN4747A
R17 33
R18 10
C15 .1 63V
L2
CR11
R16 150 5W
C13 1000 35V
C14 1 63V
JP1
R30 1k
R19 10k
R21 6.34k 1% 1/8W
R29 750 1/2W
C19 3300pF 100V
C20 .22 63V
CR15 1N4448
CR14 1N4448
CR16 1N4448
C18 .1 63V
R25 6.8k
C
R
A
VR1 TL431 2.5V REF
R24 1k
Q3 2N7000
R22 649 1% 1/8W
RT2 220
R23 200
V BATT ADJUST
R26 750 1/2W
R28 3.3k
R27 3.3k
JP2
Q4 MPS 425O
R20 150 1/2W
T2
5
4
R33 6.2k
R12 .15 1W

5–5 Ref	Part Number	Description	Usa Code	Qty REF
A3	**803724–03**	**Power Conversion PCB Assembly**		
C1	202210–000	**Capacitor**, 4700pF, 9kV		
C2	201628–018	**Capacitor**, 1.0µF/50V, 5%		
C3,4	200893–046	**Capacitor**, 1.0µF/50V, 10%		
C5	201628–077	**Capacitor**, 0.68µF/50V, 10%		
C6	200264–010	**Capacitor**, 0.01µF/50V, 20%		
C7,8	202102–030	**Capacitor**, electrolytic, 3300µF/25V, 20%		
C9	201554–068	**Capacitor**, electrolytic, 22000µF/25V, 100%		
C10	202068–001	**Capacitor**, 20µF/50V, 5%		
C11,12	201628–000	**Capacitor**, 0.001µF/50V, 5%		
C13		(Same as C2)		
C14	202068–027	**Capacitor**, 20µF/50V, 20%		
C15	200901–031	**Capacitor**, 560pF/50V, 5%		
C16		(Same as C6)		
C17		(Same as C11)		
C18	200205–035	**Capacitor**, electrolytic, 10µF/35V, +50%		
C19	201628–072	**Capacitor**, 0.1µF/50V, 10%		
C20	200901–030	**Capacitor**, 470pF/50V, 5%		
C21		(Same as C6)		
C22	200901–058	**Capacitor**, 0.1µF/50V, 5%		
C23		NOT INSTALLED		
C24,25		(Same as C7)		
C26		(Same as C18)		
C27,28		(Same as C6)		
C29		(Same as C22)		
C30		(Same as C14)		
C31	202102–004	**Capacitor**, electrolytic, 3300µF/6.3V, 20%		
C32	202102–021	**Capacitor**, electrolytic, 2200µF/16V, 20%		
C33		(Same as C19)		
C34		(Same as C5)		
C35		(Same as C3)		
C36,37		(Same as C6)		
C38	201628–006	**Capacitor**, 0.01µF/50V, 5%		
C39		(Same as C6)		
C40		(Same as C22)		
C41		(Same as C38)		
C42		(Same as C6)		

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5–5 Ref	Part Number	Description	Use Code	Qty
C43		(Same as C22)		
C44,45		(Same as C6)		
C46		(Same as C22)		
C47–50		(Same as C6)		
C51	201628–060	Capacitor, 0.001µF/50V, 10%		1
C52,53		(Same as C6)		
C54		(Same as C38)		
C55		(Same as C22)		
C56		(Same as C38)		
C57,58		(Same as C6)		
C59		(Same as C2)		
C60		(Same as C19)		
C61		(Same as C32)		
CR1	200881–004	Diode, RA2813, 250ns, PIV 12k		1
CR2	200635–053	Diode, 1.5KE82A, 113V		1
CR3	200971–000	Diode, 1N914B, 8ns, PIV 75		11
CR4	200959–003	Diode, 2N2324, 100V		1
CR5		(Same as CR3)		
CR6	200083–002	Diode, 1N5819, 1A/40V		1
CR7	201528–005	Diode, rectifier, 8A/100V		1
CR8		(Same as CR3)		
CR9,10		NOT INSTALLED		
CR11	201527–000	Wire, jumper, 0 Ω, 1/4W, 5%		4
CR12	201128–000	Diode, 3XF1, 300ns, PIV 100		1
CR13–15		(Same as CR3)		
CR17–19		(Same as CR3)		
CR20–23	200605–010	Diode, Zener, 1N4738A, 55mA/8.2V		12
CR24		(Same as CR3)		
CR25	200086–019	Diode, Zener, 1N4104, 24.8µA/10V		1
CR26	201391–005	Diode, SB320, 3A, PIV 80		1
CR27	200083–004	Diode, 1N5821, 3A/30V		1
CR28	200103–015	Diode, Zener, MPTE–22, 40A/22V		1
CR29	200658–002	Diode, MR812, 200ns, PIV 200		1
CR30		NOT INSTALLED		
CR31		(Same as CR3)		
CR32	200086–011	Diode, Zener, 1N4625, 55mA/5.1V		1
CR33–36		(Same as CR3)		
CR37–41	200991–000	Diode, 1N5711, 15mA		9
CR42,43		(Same as CR20)		

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5–5 Ref	Part Number	Description	Hosp Order	Qty
CR44,45		(Same as CR37)		
CR46		(Same as CR3)		
CR47–53		(Same as CR20)		
CR54	200605–018	**Diode**, Zener, 1N4746A, 250mA/18V		
CR55		(Same as CR20)		
CR56		(Same as CR37)		
CR57		(Same as CR3)		
CR58		(Same as CR20)		
CR59		(Same as CR37)		
F1	202293–000	**Fuse**, fast blow, 10A/125V, pigtail		
J3	201582–002	**Connector**, receptacle, 25 contact		
J10,11	201504–003	**Terminal**, quick connect, 0.187 W/0.020 T		
J12	202151–200	**Connector**, locking, 2 contact		
J13	202151–204	**Connector**, locking, 6 contact		
J15,16		(Same as J10)		
J17	201191–219	**Connector**, 14 contact		
J18	202128–024	**Connector**, 2 contact		
P14	201678–015	**Connector**, DIP, 64 contact		
Q1,2	201696–000	**Transistor**, FET, IRF540, TO–220AB		
Q3	200942–000	**Transistor**, NPN, 2N2222A, TO–18		
Q4	200994–001	**Transistor**, FET, IRF9531, TO–220		
Q5	201738–001	**Transistor**, FET, VP0106N3, TO–92		
Q6–9	200585–001	**Transistor**, FET, VN0106N3, TO–92		
Q10		(Same as Q4)		
Q11	202076–000	**Transistor**, FET, IRFD120, N–channel		
Q12		(Same as Q1)		
Q13		(Same as Q6)		
Q14		(Same as Q5)		
Q15		(Same as Q11)		
R1,2	801884–00	**Resistor**, 64MΩ, 1W, 1%		
R3	200054–370	**Resistor**, 71.5kΩ, 1/8W, 1%, RN55C		
R4	200054–341	**Resistor**, 35.7kΩ, 1/8W, 1%, RN55C		
R5	200054–288	**Resistor**, 10kΩ, 1/8W, 1%, RN55C		
R6	200676–030	**Resistor**, 120Ω, 3W, 5%		

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5–5 Ref	Part Number	Description	Use Code	Qty
R7	200054–193	Resistor, 1kΩ, 1/8W, 1%, RN55C		34
R8	200054–091	Resistor, 86.6Ω, 1/8W, 1%, RN55C		1
R9		(Same as R7)		
R10	200054–317	Resistor, 20kΩ, 1/8W, 1%, RN55C		2
R11	200054–388	Resistor, 110kΩ, 1/8W, 1%, RN55C		1
R12	200054–250	Resistor, 4.02kΩ, 1/8W, 1%, RN55C		1
R13	200054–538	Resistor, 4.12MΩ, 1/8W, 1%, RN55C		1
R14	200054–126	Resistor, 200Ω, 1/8W, 1%, RN55C		1
R15	200054–222	Resistor, 2kΩ, 1/8W, 1%, RN55C		2
R16,17	200054–001	Resistor, 10.0Ω, 1/8W, 1%, RN55C		2
R18		(Same as R5)		
R19		(Same as R7)		
R20	200054–480	Resistor, 1MΩ, 1/8W, 1%, RN55C		0
R21,22		(Same as R3)		
R23		(Same as R15)		
R24	200054–328	Resistor, 26.1kΩ, 1/8W, 1%, RN55C		1
R25		(Same as R7)		
R26	200054–239	Resistor, 3.01kΩ, 1/8W, 1%, RN55C		1
R27	200054–353	Resistor, 47.5kΩ, 1/8W, 1%, RN55C		1
R28		(Same as R15)		
R29		(Same as R5)		
R30	200054–306	Resistor, 15.4kΩ, 1/8W, 1%, RN55C		1
R31		(Same as R7)		
R33	200054–259	Resistor, 4.99kΩ, 1/8W, 1%, RN55C		2
R34		(Same as R7)		
R35		(Same as R5)		
R36	200054–384	Resistor, 100kΩ, 1/8W, 1%, RN55C		1
R37,38		(Same as R5)		
R39	200054–355	Resistor, 49.9kΩ, 1/8W, 1%, RN55C		1
R40		(Same as R15)		
R41	200054–348	Resistor, 42.2kΩ, 1/8W, 1%, RN55C		1
R42		(Same as R39)		
R43		(Same as R41)		
R44	200054–244	Resistor, 3.40kΩ, 1/8W, 1%, RN55C		1
R45		(Same as R16)		
R46,47		(Same as R7)		
R48,49	200270–000	Resistor, 0.10Ω, 2W, 5%		2
R50		(Same as R5)		

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5–5 Ref	Part Number	Description	Use Code	Qty
R51		(Same as CR11)		
R52		(Same as R5)		
R53	200054–310	**Resistor**, 16.9kΩ, 1/8W, 1%, RN55C		
R54,55		(Same as R7)		
R56		(Same as R39)		
R57		(Same as R7)		
R58–60		(Same as R5)		
R61		(Same as R7)		
R62		(Same as R48)		
R63		(Same as R36)		
R64		(Same as R20)		
R65		(Same as R12)		
R66	200054–413	**Resistor**, 200kΩ, 1/8W, 1%, RN55C		
R67		(Same as R20)		
R68	200054–265	**Resistor**, 5.76kΩ, 1/8W, 1%, RN55C		
R69		(Same as R5)		
R70		(Same as R20)		
R71		(Same as R10)		
R72,73		(Same as R20)		
R74		(Same as R5)		
R75		(Same as R10)		
R76		(Same as R5)		
R77		(Same as R33)		
R78		(Same as R10)		
R79	200054–334	**Resistor**, 30.1kΩ, 1/8W, 1%, RN55C		
R84		(Same as R15)		
R85		(Same as R7)		
R86		(Same as R10)		
R87	200054–508	**Resistor**, 2MΩ, 1/8W, 1%, RN55C		
R88,89		(Same as R20)		
R90		(Same as R10)		
R91		(Same as R7)		
R92		(Same as R5)		
R93	200054–412	**Resistor**, 196kΩ, 1/8W, 1%, RN55C		
R94		(Same as R7)		
R95		(Same as R26)		
R96		(Same as R7)		
R97		(Same as R5)		
R98,99	200054–226	**Resistor**, 2.21kΩ, 1/8W, 1%, RN55C		

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5–5 Ref	Part Number	Description	Use Until	Qty
R100,101		(Same as R5)		
R102		(Same as R7)		
R103		(Same as R98)		
R104		(Same as R5)		
R105		(Same as R7)		
R106		(Same as R5)		
R107		(Same as R7)		
R108–111		(Same as R5)		
R112,113		(Same as R7)		
R114		(Same as R98)		
R115		(Same as R7)		
R116		(Same as R98)		
R118	200054–097	**Resistor**, 100Ω, 1/8W, 1%, RN55C		1
R119		(Same as R5)		
R120		(Same as R7)		
R121		(Same as R5)		
R123		(Same as R44)		
R124		(Same as R5)		
R126,127		(Same as R5)		
R128		(Same as R7)		
R129		(Same as R5)		
R130		(Same as R98)		
R131		(Same as R5)		
R132		(Same as R33)		
R133	200054–280	**Resistor**, 8.25kΩ, 1/8W, 1%, RN55C		1
T1	804295–01	**Transformer**, flyback		1
T2	804294–01	**Transformer**, power supply		1
T3	801853–02	**Transformer**, test load		1
U1	201444–000	**IC**, linear, LM358N, op amp		4
U2	200345–000	**IC**, linear, LM393, op amp		5
U3	202050–001	**IC**, linear, 2843N, pulse-width modulator		1
U4	200933–000	**IC**, linear, LM336BZ, voltage regulator, 2.5V, T0–92		4
U5,6		(Same as U2)		
U7	202086–000	**IC**, linear, AD584JH, voltage regulator, TO-99		1
U8	200669–002	**IC**, linear, LM339, comparator		1
U9	202078–003	**IC**, interface, TLC1541, A/D converter ⚠		1
U10	201577–000	**IC**, digital, 74HC08, NAND gate ⚠		1

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5–5 Ref	Part Number	Description	Use Code
U11,12	201469–000	IC, digital, 74HC00, NAND gate ⚠	
U13	201705–000	IC, digital, 74HC14, inverter ⚠	
U14	202142–000	IC, digital, 74HC27, NOR gate	
U15	201608–000	IC, digital, 74HC02, NOR gate ⚠	
U16	201945–000	IC, digital, 74HC86, exclusive OR gate ⚠	
U17		(Same as U1)	
U18	200361–001	IC, digital, 7541KN, D/A converter ⚠	
U19,20	202085–000	IC, digital, 74HC164, shift register ⚠	
U21		(Same as U4)	
2	202221–000	**Adhesive**, hot melt (not shown, used on C7–9, C24–25)	
3	202091–035	**Heat Sink**	
4	201152–002	**Insulator**, component mount, TO–5 (not shown, used on CR4)	
5	201797–003	**Insulator**, silipad, transistor, TO–220	
6	800943–09	**Label**, symbol, international, high voltage (not shown, used on T1)	
7	201508–00	**Nut**, kep, lock, 4–40 x 0.312 L	
8	202245–001	**Rivnut**, dome head, 3/32 D x 0.187 L (not shown, used on P14)	
9	201111–038	**Screw**, binding head, nylon, 4–40 x 0.375 L	
10	201874–005	**Screw**, pan head, 4–40 x 0.312 L	
11		**Sense Leads PCB Assembly** (NOT REPAIRABLE)	
12	201756–012	**Tubing**, PVC, clear #10, 105°C (used on CR1)	
13	201535–027	**Wire**, 300V, AWG 22, white (used on CR1)	

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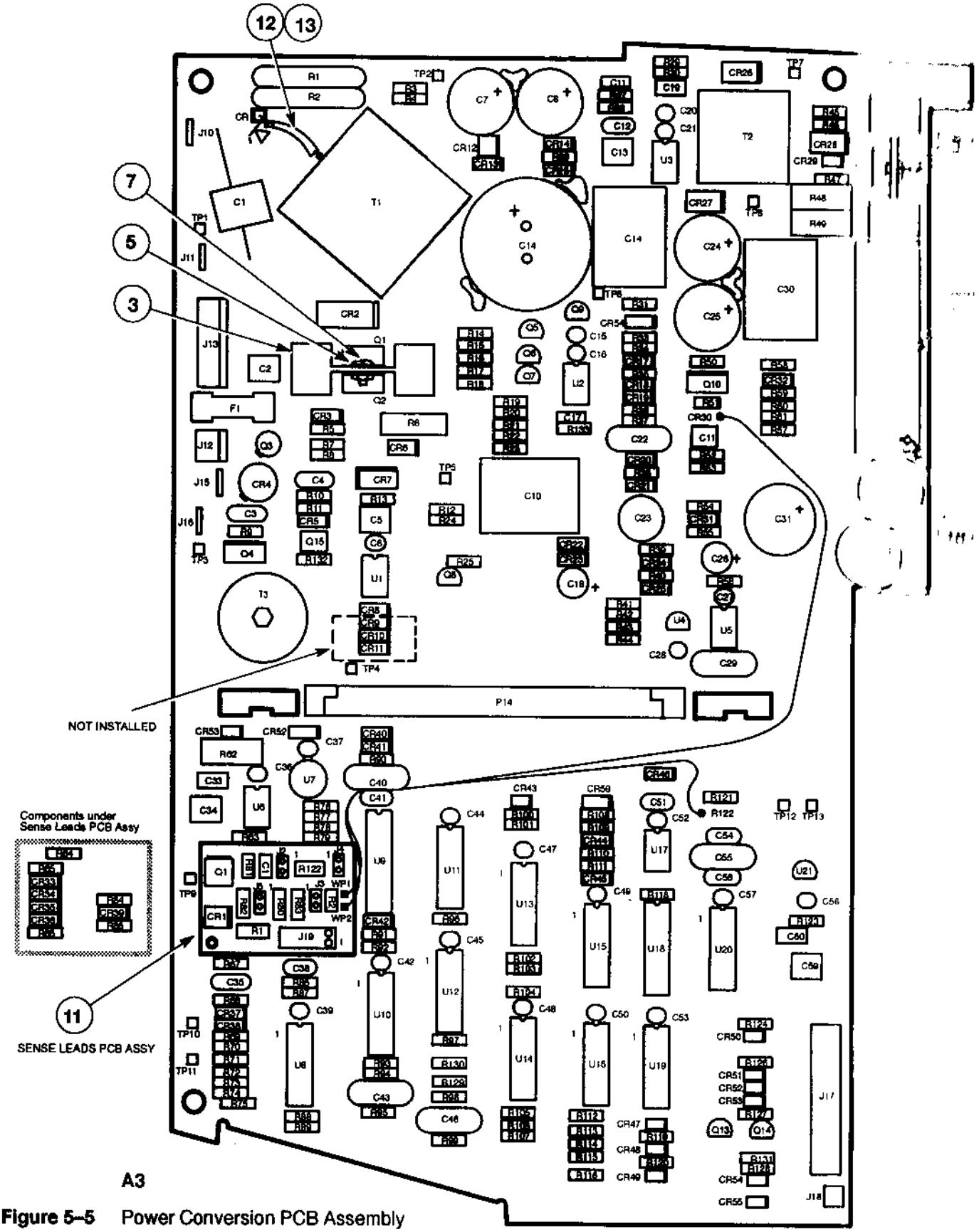

Figure 5–5 Power Conversion PCB Assembly
Part Number 803724–03
(Sheet 1 of 4)

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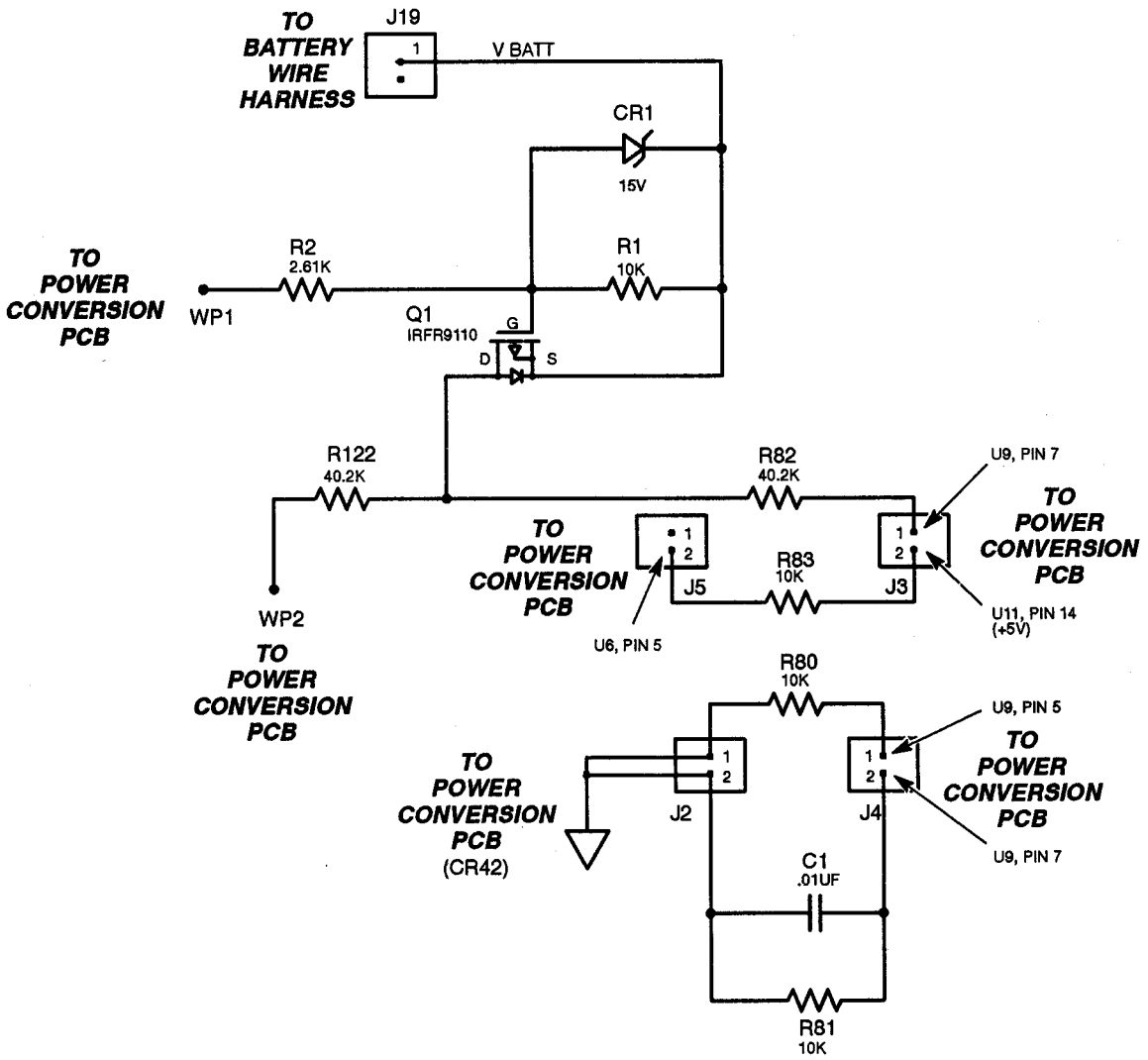
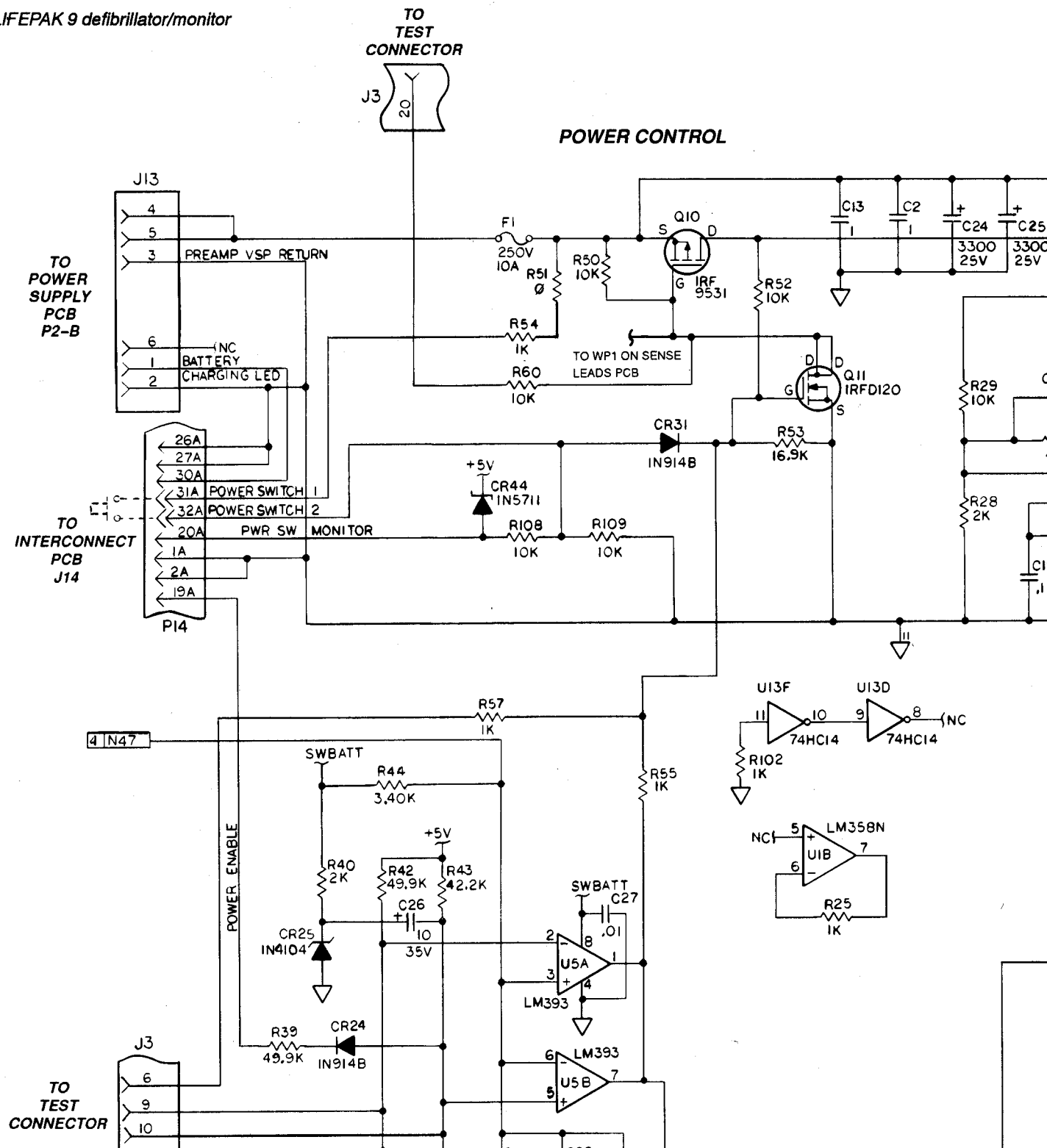
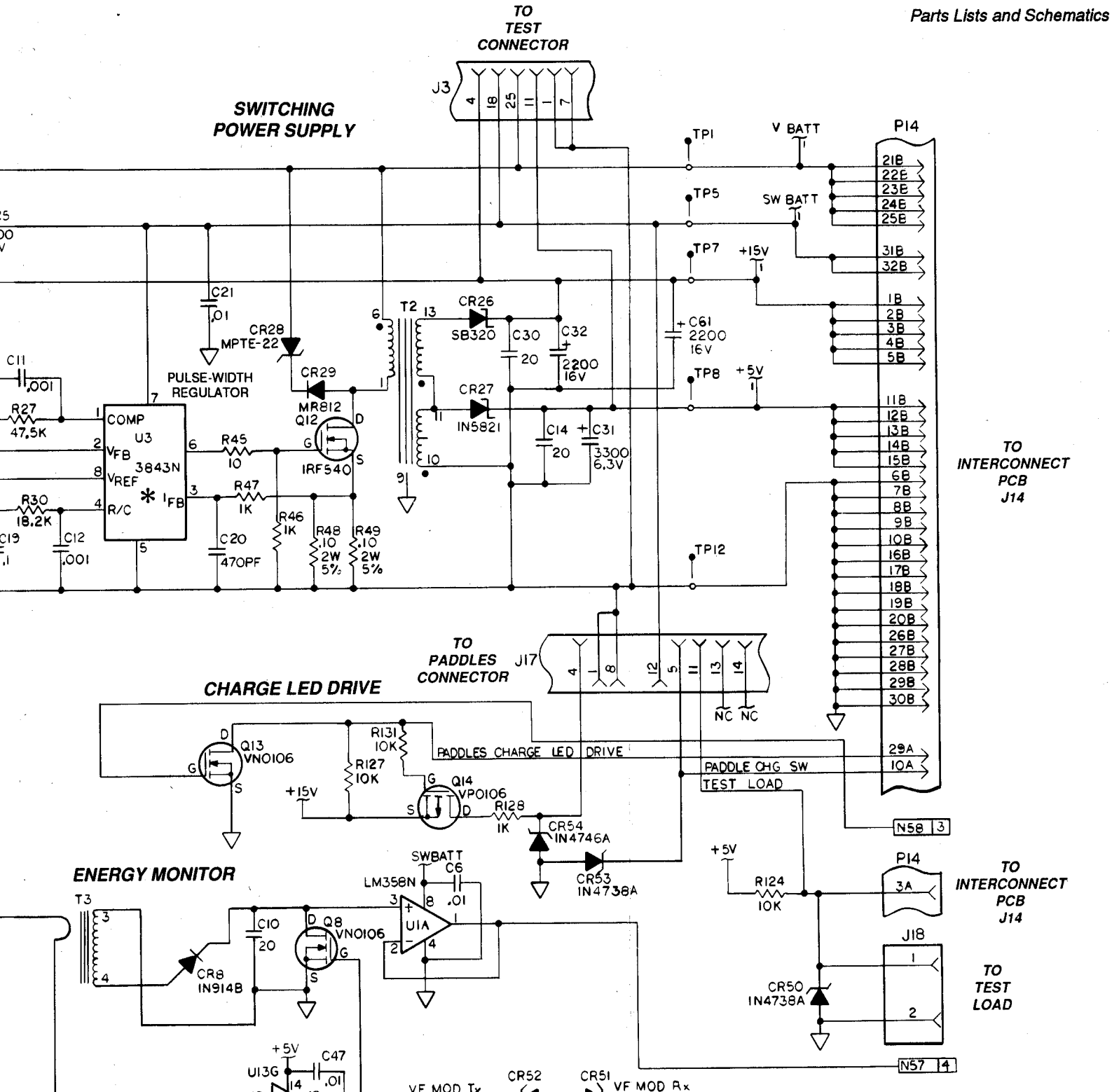
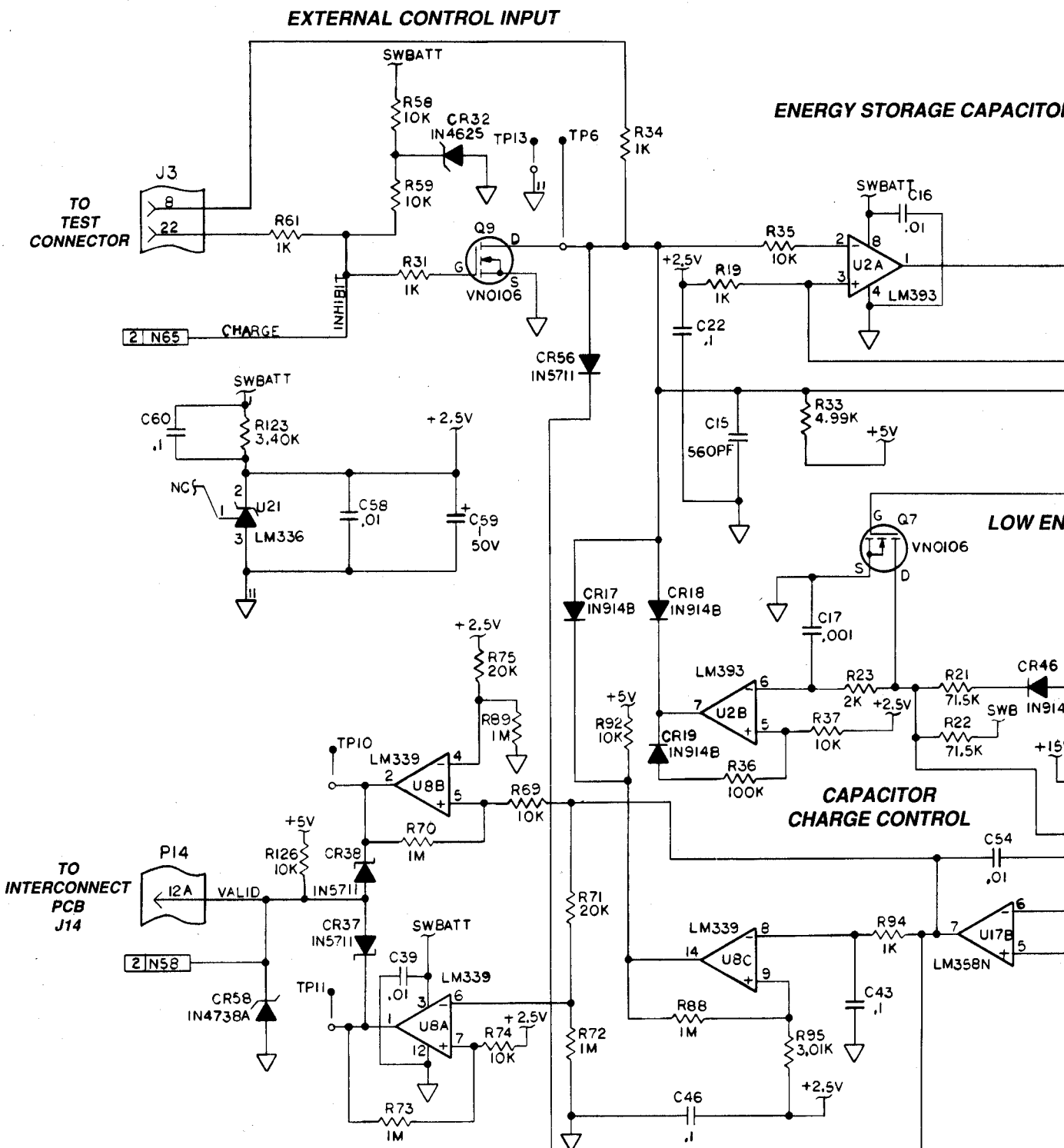


Sense Leads PCB Assembly

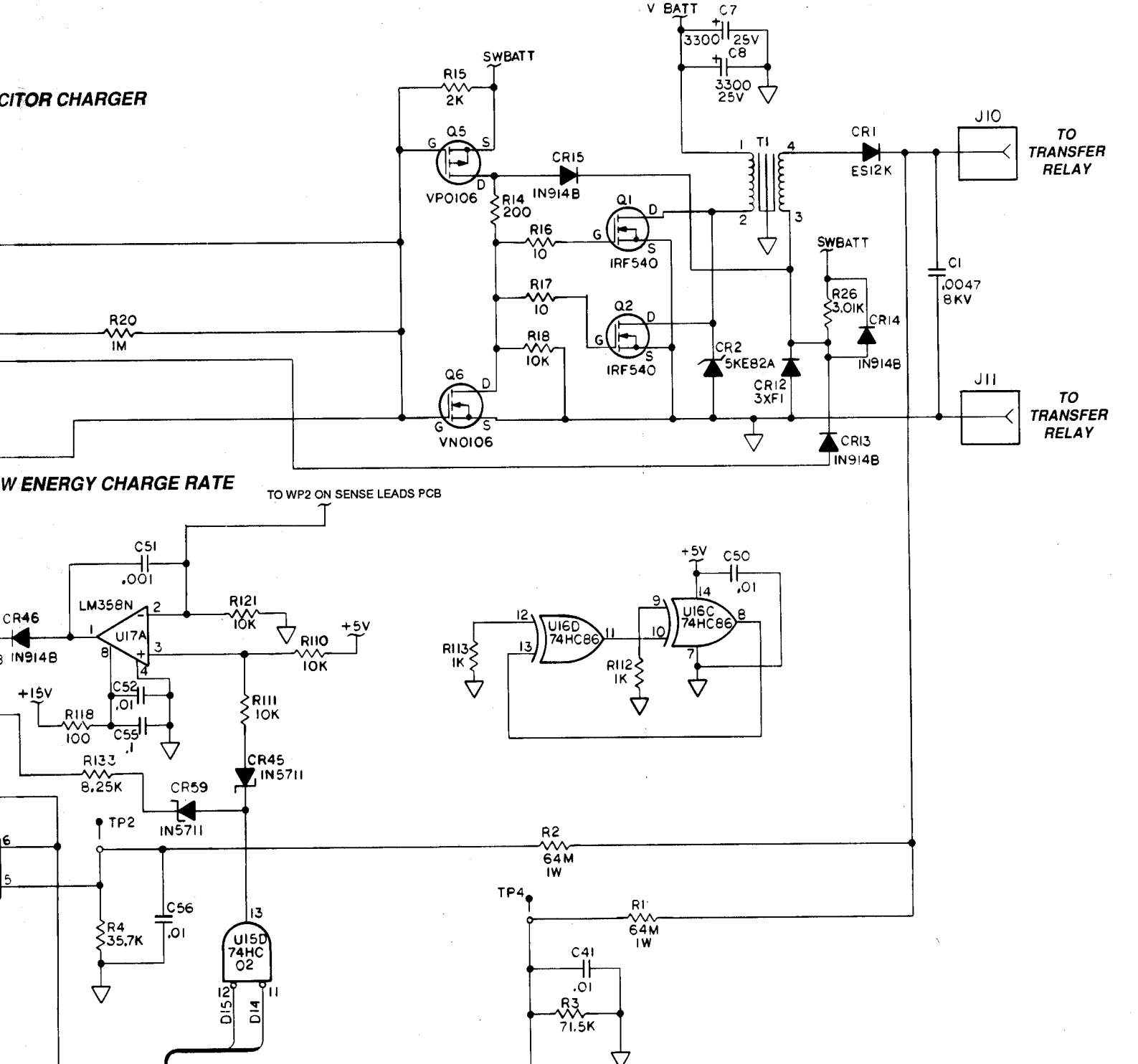

TO TEST CONNECTOR
J3
20
POWER CONTROL
J13
4
5
3
PREAMP VSP RETURN
6
1
2
NC
BATTERY
CHARGING LED
TO POWER SUPPLY PCB P2-B
F1
250V 10A
R51 Ø
R50 10K
Q10
S
D
G
IRF 9531
R52 10K
C13 1
C2 1
C24 3300 25V
C25 3300 25V
R54 1K
R60 10K
TO WP1 ON SENSE LEADS PCB
Q11 IRFD120
D
G
S
R29 10K
R28 2K
CR31
IN914B
R53 16.9K
+5V
CR44 IN5711
R108 10K
R109 10K
26A
27A
30A
31A POWER SWITCH 1
32A POWER SWITCH 2
20A PWR SW MONITOR
1A
2A
19A
P14
TO INTERCONNECT PCB J14
R57 1K
U13F
U13D
74HC14
74HC14
NC
R102 1K
4 N47
SWBATT
R44 3.40K
R55 1K
POWER ENABLE
+5V
R40 2K
R42 49.9K
R43 42.2K
C26 10 35V
CR25 IN4104
SWBATT
C27 .01
U5A
LM393
NC
LM358N
U1B
R25 1K
J3
6
9
10
TO TEST CONNECTOR
R39 49.9K
CR24 IN914B
LM393
U5B

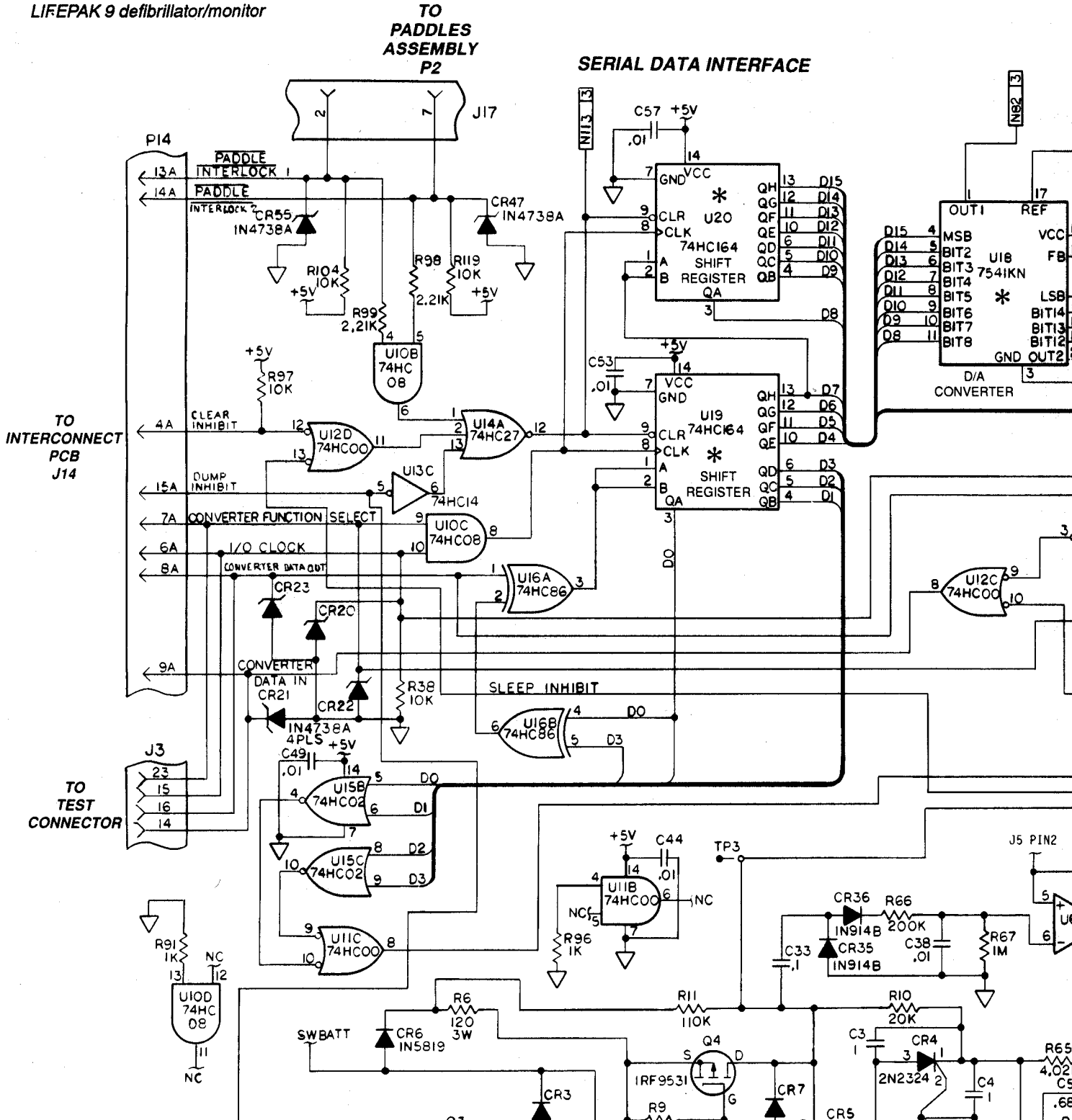

TO TEST CONNECTOR
J3
4
16
25
11
1
7
SWITCHING POWER SUPPLY
TP1
V BATT
P14
21B
22B
23B
24B
25B
TP5
SW BATT
31B
32B
TP7
+15V
1B
2B
3B
4B
5B
C21
.01
CR28
MPTE-22
T2
CR26
SB320
C30
20
C32
2200
16V
+ C61
2200
16V
C11
.001
PULSE-WIDTH REGULATOR
CR29
MR812
Q12
IRF540
CR27
IN5821
TP8
+5V
11B
12B
13B
14B
15B
6B
7B
8B
9B
10B
16B
17B
18B
19B
20B
26B
27B
28B
29B
30B
TO INTERCONNECT PCB J14
R27
47.5K
COMP
U3
3843N
VFB
VREF
R/C
IFB
R45
10
R47
1K
C14
20
C31
3300
6.3V
R30
18.2K
C12
.001
C20
470PF
R46
1K
R48
.10
2W
5%
R49
.10
2W
5%
TP12
TO PADDLES CONNECTOR
J17
4
1
8
12
5
11
13
14
NC
NC
CHARGE LED DRIVE
Q13
VN0106
R131
10K
R127
10K
+15V
Q14
VP0106
R128
1K
PADDLES CHARGE LED DRIVE
PADDLE CHG SW
TEST LOAD
29A
10A
N58 3
CR54
IN4746A
CR53
IN4738A
+5V
SWBATT
C6
.01
LM358N
U1A
ENERGY MONITOR
T3
C10
20
Q8
VN0106
CR8
IN914B
R124
10K
P14
3A
TO INTERCONNECT PCB J14
J18
1
2
TO TEST LOAD
CR50
IN4738A
+5V
C47
.01
U13G
N57 4
CR52
CR51
VF MOD Tx
VF MOD Rx

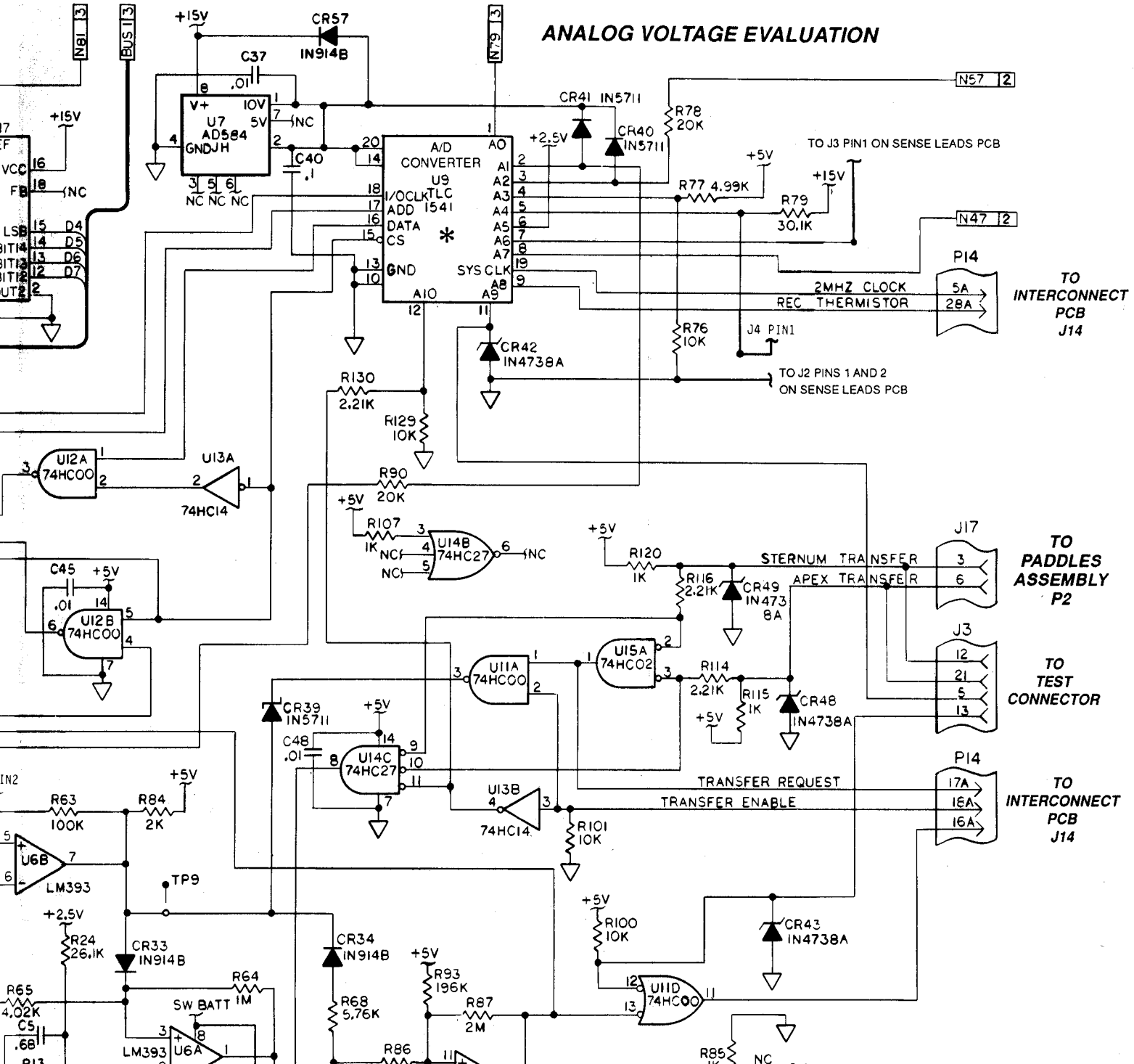

EXTERNAL CONTROL INPUT
ENERGY STORAGE CAPACITOR
LOW EN
CAPACITOR CHARGE CONTROL
TO TEST CONNECTOR
J3
SWBATT
R58 10K
CR32 IN4625
TP13
TP6
R34 1K
R59 10K
R61 1K
Q9
VN0106
R31 1K
INHIBIT
2 N65
CHARGE
R35 10K
U2A
LM393
C16 .01
+2.5V
R19 1K
C22 .1
CR56 IN5711
C60 .1
R123 3.40K
NC
U21
LM336
C58 .01
C59 50V
C15 560PF
R33 4.99K
+5V
Q7
VN0106
CR17 IN914B
CR18 IN914B
C17 .001
LM393
U2B
R23 2K
R21 71.5K
CR46
R92 10K
CR19 IN914B
R37 10K
R22 71.5K
SWB
R36 100K
R75 20K
R89 1M
TP10
LM339
U8B
R69 10K
R70 1M
R126 10K
CR38 IN5711
P14
TO INTERCONNECT PCB J14
12A
VALID
C54 .01
R71 20K
CR37 IN5711
SWBATT
C39 .01
LM339
U8C
R94 1K
U17B
LM358N
2 N58
CR58 IN4738A
TP11
U8A
R74 10K
R72 1M
R88 1M
R95 3.01K
C43 .1
R73 1M
C46 .1

CITOR CHARGER

W ENERGY CHARGE RATE




TO PADDLES ASSEMBLY P2
SERIAL DATA INTERFACE
J17
P14
PADDLE INTERLOCK 1
PADDLE INTERLOCK 2
CR55 IN4738A
CR47 IN4738A
R104 10K
R98 2.21K
R119 10K
R99 2.21K
U10B 74HC 08
R97 10K
TO INTERCONNECT PCB J14
CLEAR INHIBIT
DUMP INHIBIT
CONVERTER FUNCTION SELECT
I/O CLOCK
CONVERTER DATA OUT
U12D 74HC00
U14A 74HC27
U13C 74HC14
U10C 74HC08
U16A 74HC86
CR23
CR20
CR21
CR22
IN4738A
CONVERTER DATA IN
R38 10K
SLEEP INHIBIT
U16B 74HC86
J3
TO TEST CONNECTOR
C49 .01
U15B 74HC02
U15C 74HC02
U11C 74HC00
R91 1K
U10D 74HC 08
NC
C57 .01
U20 74HC164 SHIFT REGISTER
C53 .01
U19 74HC164 SHIFT REGISTER
U18 7541KN D/A CONVERTER
OUT1
REF
MSB
BIT2
BIT3
BIT4
BIT5
BIT6
BIT7
BIT8
VCC
FB
LSB
BIT14
BIT13
BIT12
GND
OUT2
C44 .01
U11B 74HC00
R96 1K
TP3
J5 PIN2
CR36 IN914B
CR35 IN914B
R66 200K
C38 .01
R67 1M
C33 .1
R6 120 3W
R11 110K
R10 20K
SWBATT
CR6 IN5819
Q4 IRF9531
CR3
CR7
CR5
C3 1
CR4 2N2324
C4 1
R65 4.02
C5 .68


ANALOG VOLTAGE EVALUATION
N81 3
BUS 13
N79 3
+15V
CR57
IN914B
C37
.01
U7
AD584
GNDJH
10V
5V
NC
C40
.1
NC NC NC
A/D
CONVERTER
U9
TLC
1541
I/OCLK
ADD
DATA
CS
GND
SYS CLK
AO
AI
A2
A3
A4
A5
A6
A7
A8
A9
A10
CR41 IN5711
CR40
IN5711
+2.5V
R78
20K
N57 2
TO J3 PIN1 ON SENSE LEADS PCB
+5V
+15V
R77 4.99K
R79
30.1K
N47 2
P14
2MHZ CLOCK
REC THERMISTOR
5A
28A
TO INTERCONNECT PCB J14
R76
10K
J4 PIN1
CR42
IN4738A
TO J2 PINS 1 AND 2 ON SENSE LEADS PCB
R130
2.21K
R129
10K
U12A
74HC00
U13A
74HC14
R90
20K
+5V
R107
1K
NC
U14B
74HC27
C45
.01
U12B
74HC00
R120
1K
R116
2.21K
CR49
IN4738A
STERNUM TRANSFER
APEX TRANSFER
J17
3
6
TO PADDLES ASSEMBLY P2
J3
12
21
5
13
TO TEST CONNECTOR
U11A
74HC00
U15A
74HC02
R114
2.21K
R115
1K
CR48
IN4738A
CR39
IN5711
C48
.01
U14C
74HC27
U13B
74HC14
TRANSFER REQUEST
TRANSFER ENABLE
17A
16A
16A
TO INTERCONNECT PCB J14
R101
10K
R63
100K
R84
2K
U6B
LM393
TP9
+2.5V
R24
26.1K
CR33
IN914B
R64
SW BATT 1M
R65
4.02K
C5
.68
LM393
U6A
CR34
IN914B
R68
5.76K
R93
196K
R87
2M
R86
R100
10K
U11D
74HC00
CR43
IN4738A
R85
NC

5–6 Ref	Part Number	Description	Use Code	Qty REF
A4	**803706–00**	**Display Assembly**		
2	DOT6–002–1678	**Monitor PCB Assembly**		1
3	DOT73027887–913	**CRT/Yoke Assembly**		1
4	DOT–048–0110	**Cable Tie,** nylon (not shown, used in five places)		5
5	DOT15005406–000	**Clamp,** hose, nylon		1
6	DOT6–004–1150	**CRT Connector Assembly**		1
7	DOT6–004–0452	**Deflection Coil Assembly**		1
8	DOT5–014–0393	**Label,** HV caution (not shown, used on item 3)		1
9	DOT5–014–0430	**Label,** model, serial number (not shown, used in item 3)		1
10	DOT32028970–007	**Label,** X–ray warning (not shown, used in item 3)		1
11	804117–00	**Mount,** CRT, front		1
12	804118–00	**Mount,** CRT, rear		1
13	DOT3–011–0520	**Screw,** pan head, 8–32 x 0.357 L		4
14	DOT2–049–0256	**Tape,** 3/4in adhesive (not shown, used in item 3)		6
15	DOT3–013–0190	**Washer,** flat, #8		4
16	DOT3–013–0182	**Washer,** lock, #8		4

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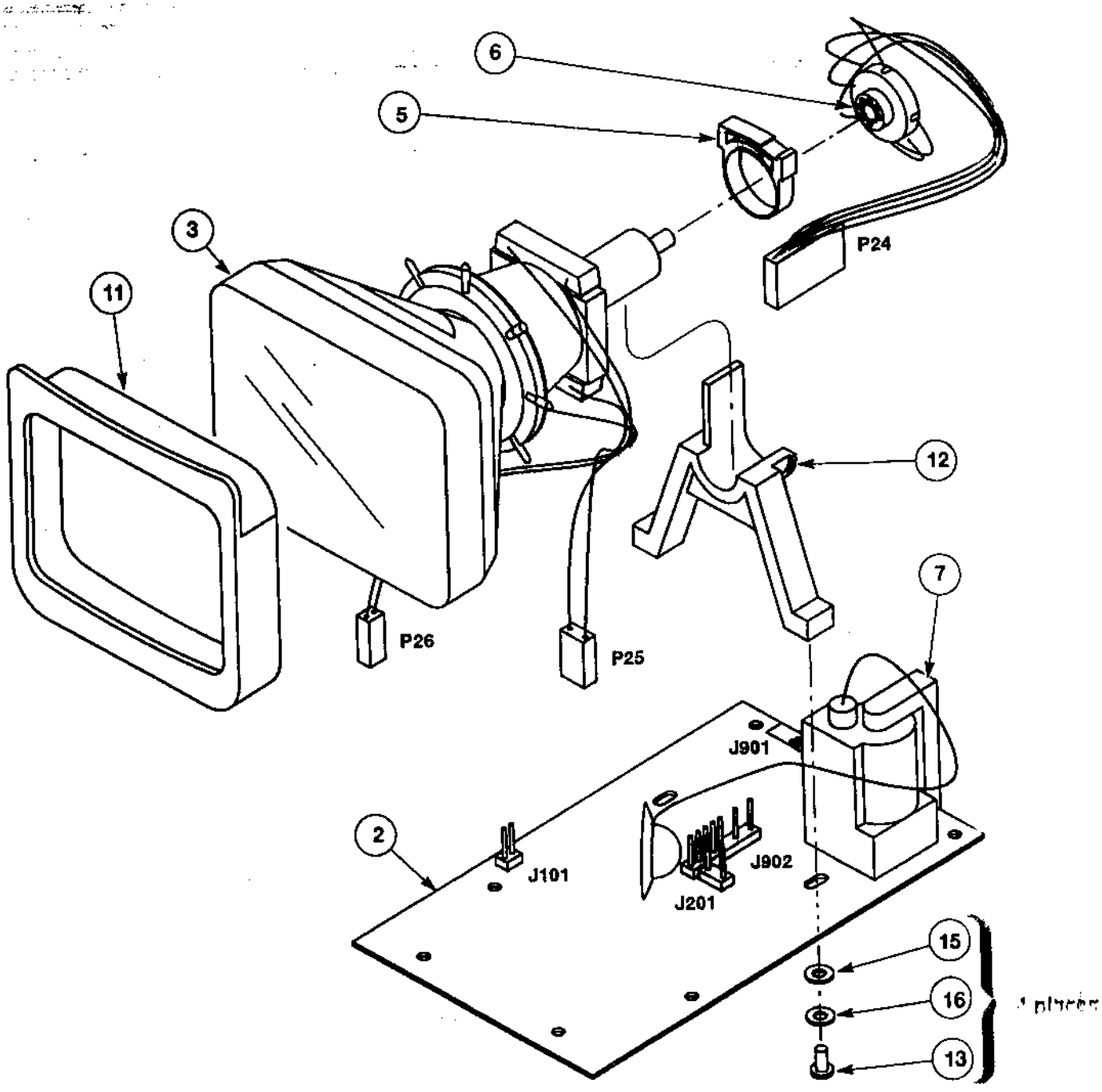

A4

Figure 5–6 Display Assembly
Part Number 803706–00
(Sheet 1 of 4)

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5–6 Ref	Part Number	Description	Use Code	Qty Req
	DOT6–002–1678	**Monitor PCB Assembly** (part of Display Assembly)		
C101	DOT1–012–2455	**Capacitor**, 0.1µF, 50V, 20%		
C102	DOT1–012–2341	**Capacitor**, 1000µF, 25V		
C103	DOT1–012–2359	**Capacitor**, 0.15µF, 100V, 5%		
C104	DOT1–012–2454	**Capacitor**, 0.01µF, 50V, 20%		
C105	DOT1–012–2358	**Capacitor**, 100µF, 50V		
C106, 107	DOT61220027–000	**Capacitor**, 0.1µF, 50V		
C108	DOT1–012–2511	**Capacitor**, 5600pF, 50V, 5%		
C109	DOT1–012–0300	**Capacitor**, 100pF, 500V, 5%		
C110		(Same as C101)		
C111	DOT61025449–019	**Capacitor**, electrolytic, 22µF, 16V, 20%		
C112	DOT1–012–2444	**Capacitor**, 1000µF, 16V, 20%		
C201	DOT1–012–2403	**Capacitor**, 1000pF, 100V		
C202	DOT1–012–2680	**Capacitor**, 1000pF, 100V, 5%		
C203	DOT1–012–2211	**Capacitor**, 10µF, 25V		
C204	DOT1–012–2347	**Capacitor**, 470µF, 35V		
C205–207		(Same as C101)		
C208	DOT61220013–002	**Capacitor**, 0.0047µF, 1kV, 5%		
C209	DOT61220013–001	**Capacitor**, 0.01µF, 1kV, 5%		
C210	DOT61220016–010	**Capacitor**, 2.2µF, 160V, 5%		
C211	DOT61220016–009	**Capacitor**, 1µF, 160V, 5%		
C212	DOT1–012–2419	**Capacitor**, 220pF, 500V, 5%		
C213		(Same as C101)		
C214		(Same as C105)		
C301		(Same as C104)		
C302	DOT1–012–2214	**Capacitor**, 0.01µF, 1000V, 20%		
C303	DOT1–012–2228	**Capacitor**, 3.3µF, 250V		
C304, 305		(Same as C302)		
C306	DOT1–012–2375	**Capacitor**, 0.1µF, 500V, 20%		
C307		(Same as C303)		
C401		(Same as C203)		
C402		(Same as C101)		
C406, 407		(Same as C101)		
C408	DOT1–012–2250	**Capacitor**, 47µF, 100V		
C501, 502		(Same as C101)		
C503	DOT1–012–2627	**Capacitor**, 100µF, 35V, 20%		
C504		(Same as C101)		

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5–6 Ref	Part Number	Description	Use Code	Qty
C505		(Same as C503)		
C506		(Same as C101)		
D101	DOT1–021–0545	**Diode**, 1N4002, 100V, 1A		4
D201	DOT1–021–0517	**Diode**, Zener, Z0517, 18V		1
D202	DOT1–021–0497	**Diode**, 1N5282		4
D203	DOT1–021–0542	**Diode**, UF5404		1
D301	DOT58026488–002	**Diode**, RGP01–018, 1800V, 100mA		1
D302	DOT1–021–0507	**Diode**, 1N4937, 600V, 1A		1
D303	DOT58005767–019	**Diode**, Zener, 1N997, 33V, 5%		1
D401–404	DOT1–021–0550	**Diode**, 1N916, 100V, 75mA, 2%		4
D501		(Same as D101)		
D502, 503	DOT1–021–0543	**Diode**, UF4004, 400V		4
D506		(Same as D202)		
H201	DOT1–015–5081	**Heat Sink**		4
H401	DOT1–015–5134	**Heat Sink**		1
H501		(Same as H201)		
J101	DOT30005029–002	**Connector**, 2 contact		1
J201	DOT30005029–003	**Connector**, 3 contact		1
J901	DOT30257732–020	**Connector**, 20 contact		1
J902	DOT1–034–0416	**Connector**, 9 contact		1
L201	DOT1–016–0463	**Coil**, horizontal linearity		1
L401	DOT1–016–0397	**Coil**, fixed, 8.2µH		1
L501	DOT29002450–005	**Ferrit Bead**		1
Q201	DOT1–015–1144	**Transistor**, 2N3904, NPN		4
Q202	DOT1–015–1145	**Transistor**, 2N3906, PNP		3
Q203		(Same as Q201)		
Q204		(Same as Q202)		
Q205	DOT58025451–025	**Transistor**, FET, BUZ60, 400V, TO 220		1
Q401	DOT1–015–1205	**Transistor**, 2N3053A, NPN		1
Q501		(Same as Q202)		
Q502	DOT58025451–026	**Transistor**, FET, MTP10N15, 10A, 150V		1
R102	DOT1–011–2597	**Resistor**, 330Ω, 1/4W, 5%		4
R104	DOT1–011–2551	**Resistor**, 10Ω, 1/4W, 5%		1
R105	DOT1–011–2555	**Resistor**, 100kΩ, 1/4W, 5%		3

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5–6 Ref	Part Number	Description	Use Code	Qty
R106	DOT1–011–5758	**Potentiometer**, 100kΩ, 1/8W, 20%		
R107	DOT1–011–2553	**Resistor**, 1kΩ, 1/4W, 5%		
R108	DOT1–011–2613	**Resistor**, 4.7kΩ, 1/4W, 5%		
R109	DOT1–011–2862	**Resistor**, 300kΩ, 1/4W, 5%		
R110	DOT1–011–2608	**Resistor**, 390kΩ, 1/4W, 5%		
R111	DOT1–011–5759	**Potentiometer**, 250kΩ, 1/8W, 20%		
R112	DOT1–011–2556	**Resistor**, 1MΩ, 1/4W, 5%		
R113		(Same as R106)		
R114	DOT1–011–2599	**Resistor**, 33kΩ, 1/4W, 5%		
R115	DOT1–011–2614	**Resistor**, 47kΩ, 1/4W, 5%		
R116	DOT1–011–2582	**Resistor**, 220kΩ, 1/4W, 5%		
R117	DOT1–011–2702	**Resistor**, 3.3Ω, 1/4W, 5%		
R118–120	DOT1–011–2620	**Resistor**, 5.6kΩ, 1/4W, 5%		
R121	DOT1–011–2704	**Resistor**, 1Ω, 1/2W, 5%		
R122	DOT1–011–2258	**Resistor**, 330Ω, 1/2W, 5%		
R201	DOT1–011–2579	**Resistor**, 220Ω, 1/4W, 5%		
R202		(Same as R102)		
R203	DOT1–011–2552	**Resistor**, 100Ω, 1/4W, 5%		
R204		(Same as R107)		
R205		(Same as R108)		
R206		(Same as R105)		
R207		(Same as R107)		
R208	DOT1–011–2580	**Resistor**, 2.2kΩ, 1/4W, 5%		
R209		(Same as R104)		
R210		(Same as R203)		
R211	DOT1–011–2619	**Resistor**, 560Ω, 1/4W, 5%		
R212		(Same as R107)		
R213		(Same as R118)		
R214	DOT1–011–2554	**Resistor**, 10kΩ, 1/4W, 5%		
R215		(Same as R107)		
R216		(Same as R214)		
R217		(Same as R105)		
R218		(Same as R112)		
R219		(Same as R114)		
R220	DOT69008520–025	**Resistor**, 24.9kΩ, 1/4W, 1%		
R221	DOT1–038–0212	**Jumper Wire**, 22 AWG		
R223		(Same as R107)		
R224	DOT1–011–5822	**Potentiometer**, 1kΩ, 1/8W, 20%		

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5–6 Ref	Part Number	Description	Use Code	Qty
R225		(Same as R107)		
R226		(Same as R104)		
R227		(Same as R107)		
R228	DOT1–011–2878	Resistor, 0.22Ω, 1W, 5%		1
R301		(Same as R214)		
R302	DOT1–011–5783	Potentiometer, 7.5MΩ, 1W, 20%		1
R303, 304	DOT1–011–2570	Resistor, 150kΩ, 1/4W, 5%		2
R305	DOT1–011–2353	Resistor, 3MΩ, 1/2W, 5%		1
R306		(Same as R302)		
R307	DOT1–011–2639	Resistor, 820kΩ, 1/4W, 5%		1
R308		(Same as R214)		
R309		(Same as R214)		
R310		(Same as R107)		
R311	DOT1–011–2615	Resistor, 470kΩ, 1/4W, 5%		1
R312		(Same as R214)		
R313	DOT1–011–2745	Resistor, 4.7MΩ, 1/4W, 5%		1
R401	DOT1–011–2713	Resistor, 56Ω, 1/4W, 5%		1
R402	DOT1–011–5755	Potentiometer, 500Ω, 1/8W, 20%		1
R403	DOT1–011–2628	Resistor, 680Ω, 1/4W, 5%		1
R404		(Same as R104)		
R406	DOT1–011–2567	Resistor, 150Ω, 1/4W, 5%		2
R407	DOT69008520–027	Resistor, 340Ω, 1/4W, 1%		1
R409		(Same as R406)		
R410	DOT69008520–024	Resistor, 169Ω, 1/4W, 1%		1
R411	DOT1–011–2835	Resistor, 118Ω, 1/4W, 1%		1
R412, 413	DOT1–011–2893	Resistor, 300Ω, 2W, 5%		2
R414	DOT1–011–2596	Resistor, 33Ω, 1/4W, 5%		1
R415	DOT1–011–2294	Resistor, 10kΩ, 1/4W, 5%		1
R501, 502	DOT1–011–2635	Resistor, 82Ω, 1/4W, 5%		2
R503		(Same as R203)		
R504		(Same as R107)		
T301	DOT1–017–5574	Transformer, flyback, HFS, 32kHz		1
T501	DOT1–017–5573	Transformer, DC–DC, HFS–5		1
U101	DOT64025455–002	IC, TDA1170N, deflection circuit		1
U201	DOT1–025–0206	IC, TL494CN, voltage regulator		1
U401	DOT64200005–053	IC, 74128 quad 2–Input NOR		1
U501	DOT1–025–0143	IC, 78MO5CT, voltage regulator, +5V, TO–2		1

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5–6 Ref	Part Number	Description	Use Code	Qty
W203	DOT1–045–5000	**Jumper Wire**, 22 AWG		2
W205		(Same as W203)		
W301, 302	DOT1–038–0212	**Solid Wire**, 22 AWG		2
2	DOT3–012–0140	**Nut**, hex, 4–40		2
3	DOT3–011–1044	**Screw**, 4–40 x 5/16		2
4	DOT3–015–0125	**Spring**, DAG, 1/4 OD		1
5	DOT3–013–0140	**Washer**, lock #4		2

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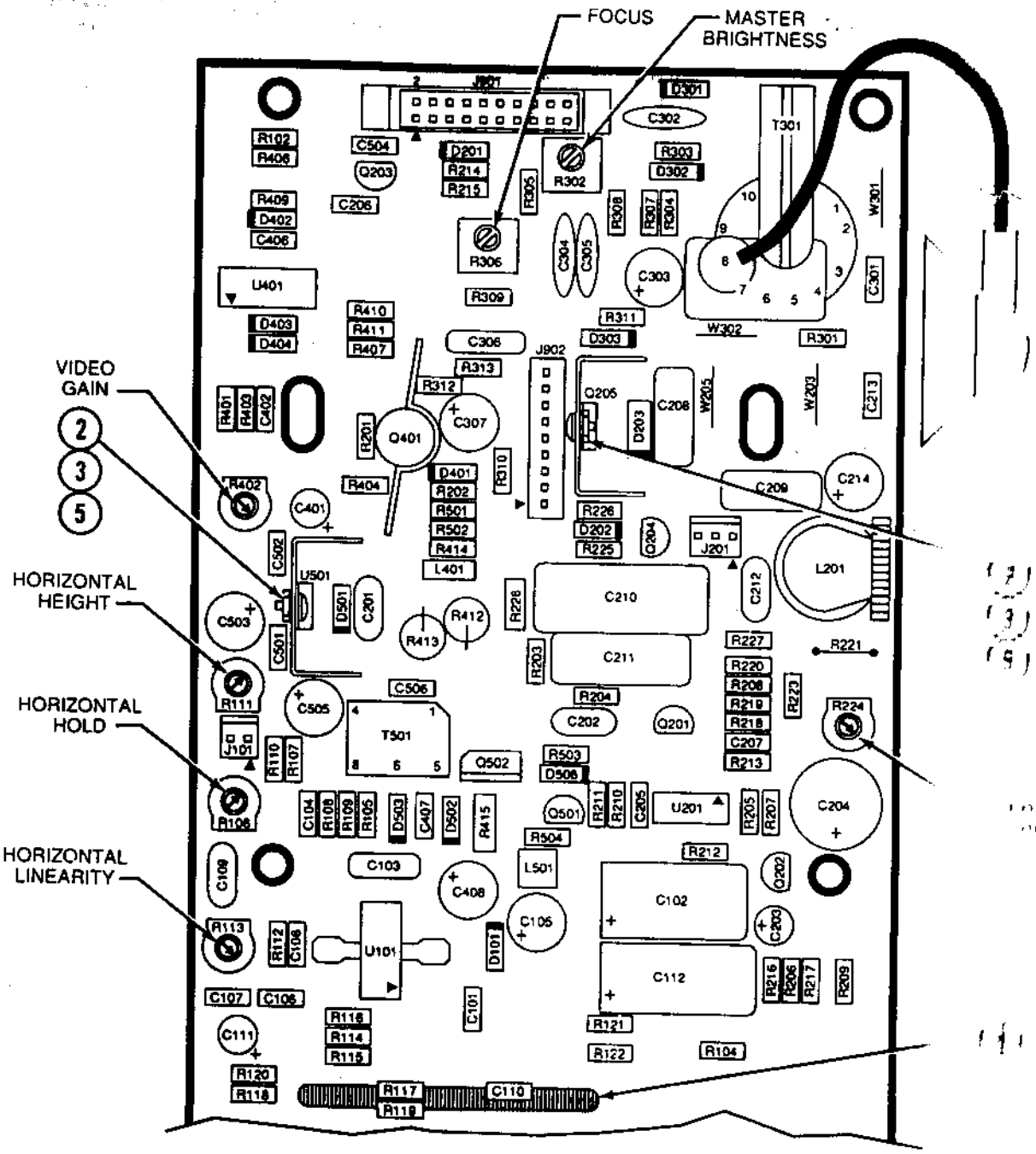

A4

Figure 5–6 Monitor PCB
(part of Display Assembly)
Part Number 803706
(Sheet 2 of 4)

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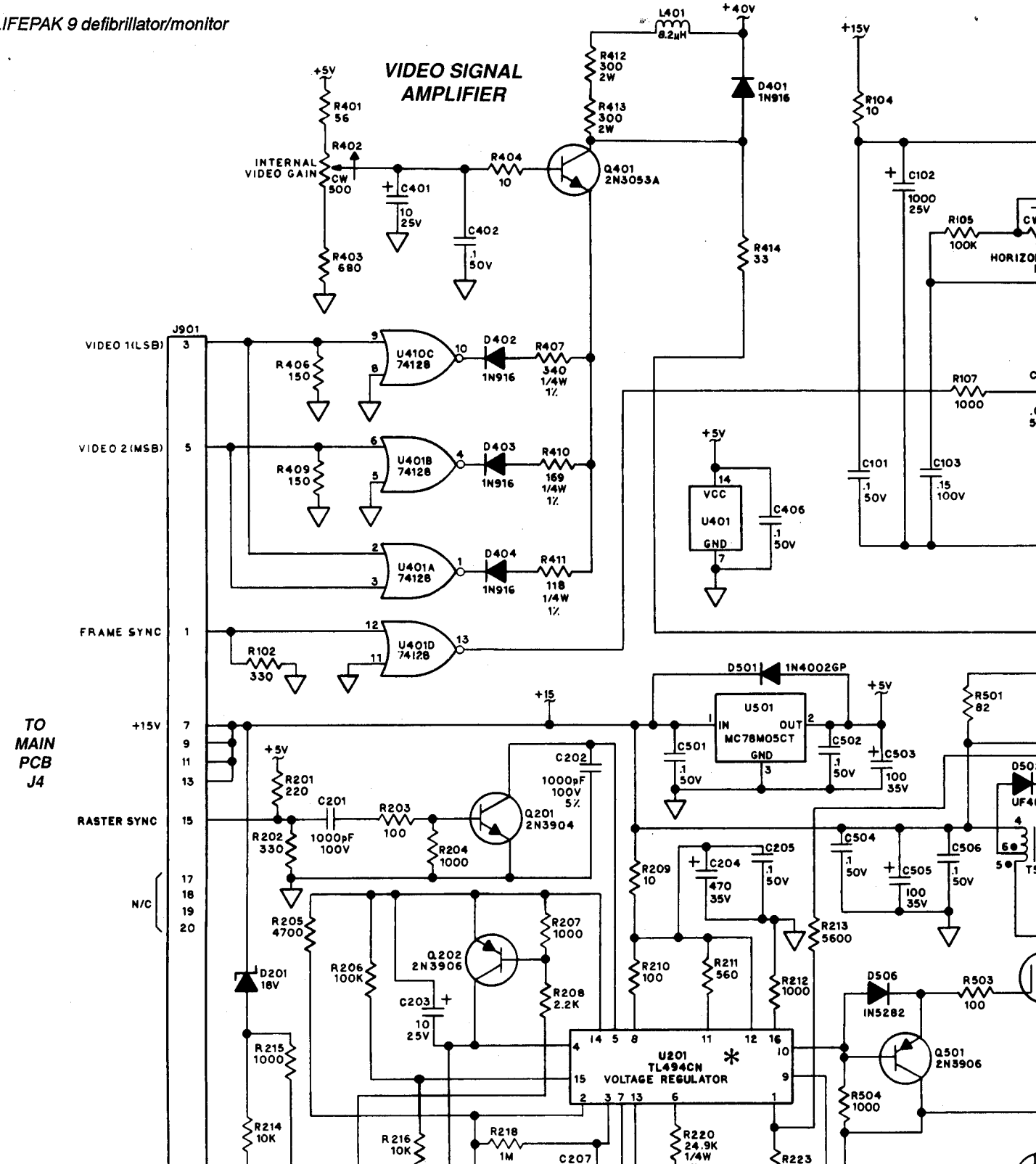
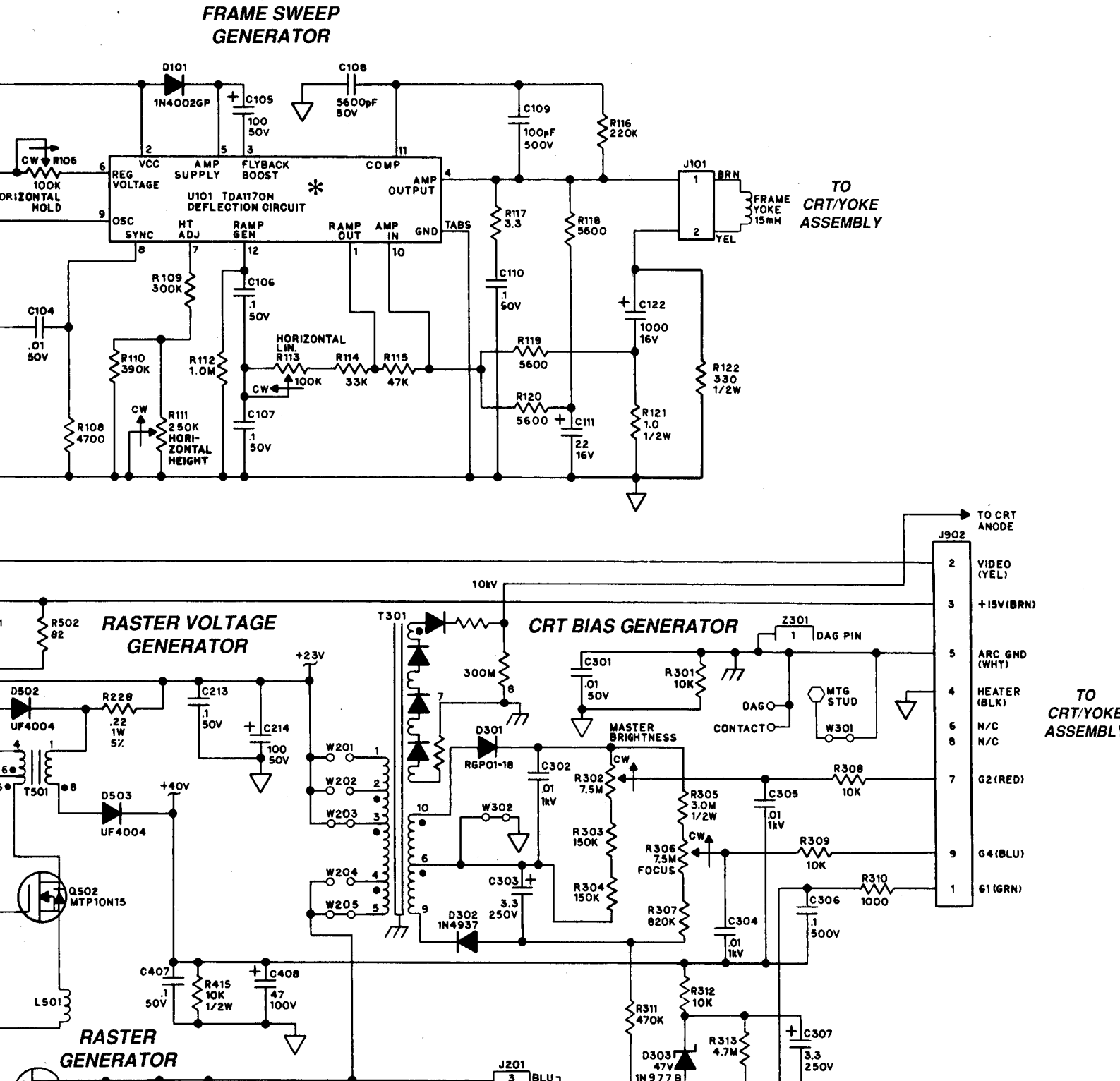
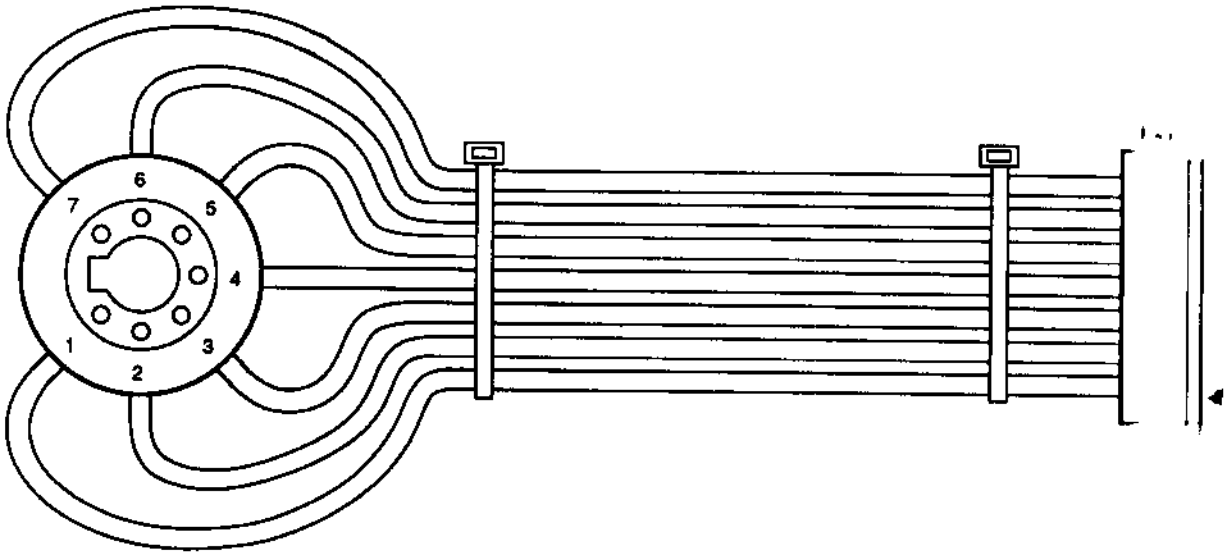
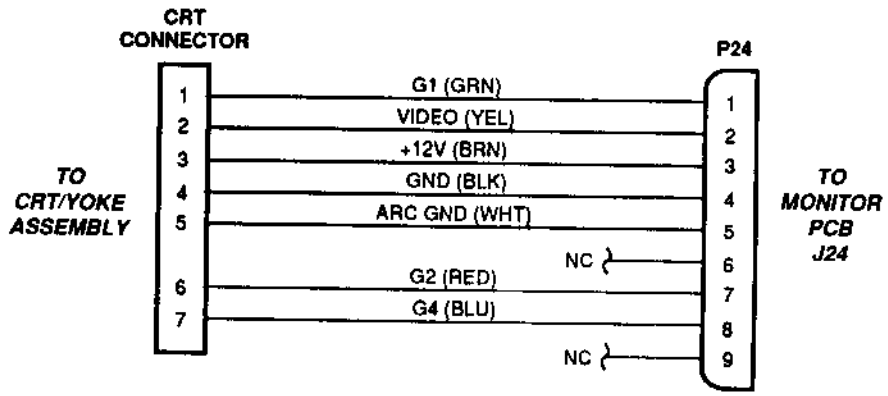

VIDEO SIGNAL AMPLIFIER
L401 8.2uH
+40V
D401 1N916
R412 300 2W
R413 300 2W
R414 33
+5V
R401 56
R402 INTERNAL VIDEO GAIN CW 500
R403 680
C401 10 25V
C402 .1 50V
R404 10
Q401 2N3053A
+15V
R104 10
C102 1000 25V
R105 100K
R107 1000
C101 .1 50V
C103 .15 100V
J901
VIDEO 1(LSB) 3
VIDEO 2(MSB) 5
FRAME SYNC 1
R406 150
R409 150
R102 330
U410C 74128
U401B 74128
U401A 74128
U401D 74128
D402 1N916
D403 1N916
D404 1N916
R407 340 1/4W 1%
R410 169 1/4W 1%
R411 118 1/4W 1%
U401 VCC GND
C406 .1 50V
TO MAIN PCB J4
+15V 7 9 11 13
RASTER SYNC 15
N/C 17 18 19 20
D501 1N4002GP
U501 MC78M05CT IN OUT GND
C501 .1 50V
C502 .1 50V
C503 100 35V
R501 82
R201 220
R202 330
C201 1000pF 100V
R203 100
R204 1000
Q201 2N3904
C202 1000pF 100V 5%
C204 470 35V
C205 .1 50V
C504 .1 50V
C505 100 35V
C506 .1 50V
R209 10
R213 5600
R205 4700
R206 100K
R207 1000
R208 2.2K
Q202 2N3906
C203 10 25V
D201 18V
R210 100
R211 560
R212 1000
D506 IN5282
R503 100
Q501 2N3906
R504 1000
R215 1000
R214 10K
R216 10K
R218 1M
C207
R220 24.9K 1/4W
R223
U201 TL494CN VOLTAGE REGULATOR *


FRAME SWEEP GENERATOR
D101
1N4002GP
C105
100
50V
C108
5600pF
50V
C109
100pF
500V
R116
220K
CW
R106
100K
HORIZONTAL HOLD
VCC
AMP SUPPLY
FLYBACK BOOST
COMP
REG VOLTAGE
U101 TDA1170N
DEFLECTION CIRCUIT
AMP OUTPUT
OSC
SYNC
HT ADJ
RAMP GEN
RAMP OUT
AMP IN
GND
TABS
J101
BRN
YEL
FRAME YOKE 15mH
TO CRT/YOKE ASSEMBLY
R117
3.3
C110
.1
50V
R118
5600
C122
1000
16V
R122
330
1/2W
R109
300K
C106
.1
50V
C104
.01
50V
HORIZONTAL LIN.
R113
100K
R114
33K
R115
47K
R119
5600
R120
5600
C111
22
16V
R121
1.0
1/2W
R110
390K
R112
1.0M
CW
C107
.1
50V
R108
4700
CW
R111
250K
HORI-ZONTAL HEIGHT
TO CRT ANODE
J902
2 VIDEO (YEL)
3 +15V(BRN)
5 ARC GND (WHT)
4 HEATER (BLK)
6 N/C
8 N/C
7 G2(RED)
9 G4(BLU)
1 G1(GRN)
TO CRT/YOKE ASSEMBLY
10kV
T301
RASTER VOLTAGE GENERATOR
CRT BIAS GENERATOR
R502
82
D502
UF4004
R228
.22
1W
5%
C213
.1
50V
C214
100
50V
+23V
300M
Z301
1
DAG PIN
C301
.01
50V
R301
10K
DAG
CONTACT
MTG STUD
W301
D301
RGP01-18
MASTER BRIGHTNESS
C302
.01
1kV
R302
7.5M
CW
R305
3.0M
1/2W
C305
.01
1kV
R308
10K
W201
W202
W203
W204
W205
W302
R303
150K
R306
7.5M
FOCUS
R309
10K
R304
150K
C303
3.3
250V
R307
820K
C304
.01
1kV
C306
.1
500V
R310
1000
D302
1N4937
T501
D503
UF4004
+40V
Q502
MTP10N15
L501
C407
.1
50V
R415
10K
1/2W
C408
47
100V
R311
470K
R312
10K
R313
4.7M
C307
3.3
250V
D303
47V
1N977B
RASTER GENERATOR
J201
3 BLU

5–6 Ref	Part Number	Description	Use Code	Qty
	DOT6–004–1150	**CRT Connector Assembly** (part of Display Assembly)		





A4

Figure 5–6 Display Assembly Part Number ... (Sheet 4 of 4)

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5–7 Ref	Part Number	Description	Use Code	Qty
A5	**803761–00**	**Interconnect PCB Assembly**		REF
C1–3	201628–120	**Capacitor**, 0.001µF/50V, 20%		1
C4	201628–132	**Capacitor**, 0.1µF/50V, 20%		1
C5–8		(Same as C1)		
C9	201628–012	**Capacitor**, 0.1µF/50V, 5%		1
C10	201628–007	**Capacitor**, 0.015µF/50V, 5%		1
C11	201628–014	**Capacitor**, 0.22µF/50V, 5%		1
C12	201628–018	**Capacitor**, 1µF/50V, 5%		1
C13	202102–024	**Capacitor**, electrolytic, 330µF/25V		
C14		(Same as C9)		
CR1,2	200605–010	**Diode**, Zener, 1N4738A, 550mA/8.2V		1
CR3	200605–018	**Diode**, Zener, 1N4746A, 250mA/18V		1
CR4		(Same as CR1)		
CR5		(Same as CR3)		
CR6–9		(Same as CR1)		
CR10,11		(Same as CR3)		
CR12	201749–012	**Diode**, transzorb, SA176		1
J7	201678–035	**Connector**, plug, 90°, 96 contact		1
J14	201678–028	**Connector**, plug, 90°, 64 contact		1
J19	201191–230	**Connector**, plug, 90°, 20 contact		1
J29	202128–048	**Connector**, header, 90°, 2 contact		1
Q1–13	200585–001	**Transistor**, FET, VN0106N3, TO–92 ▲		13
R1–4	200054–226	**Resistor**, 2.21kΩ, 1/8W, 1%, RN55C		1
R5	200054–315	**Resistor**, 19.1kΩ, 1/8W, 1%, RN55C		1
R6	200054–275	**Resistor**, 7.32kΩ, 1/8W, 1%, RN55C		1
R7	200054–256	**Resistor**, 4.64kΩ, 1/8W, 1%, RN55C		1

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5–7 Ref	Part Number	Description	Use Code	Qty
R8	200054–288	**Resistor**, 10kΩ, 1/8W, 1%, RN55C		3
R9		(Same as R1)		
R10		(Same as R8)		
R11	200054–189	**Resistor**, 909Ω, 1/8W, 1%, RN55C		2
R12	200054–364	**Resistor**, 61.9kΩ, 1/8W, 1%, RN55C		1
R13	200054–231	**Resistor**, 2.49kΩ, 1/8W, 1%, RN55C		1
R14,15		(Same as R11)		
R16		(Same as R12)		
R17	200054–203	**Resistor**, 1.27kΩ, 1/8W, 1%, RN55C		1
R18	200054–183	**Resistor**, 787Ω, 1/8W, 1%, RN55C		1
R19	200054–172	**Resistor**, 604Ω, 1/8W, 1%, RN55C		1
R20	200850–149	**Resistor**, 348Ω, 1/2W, 1%		1
R21,22		(Same as R1)		
R23	200054–175	**Resistor**, 649Ω, 1/8W, 1%, RN55C		1
R24–26	200054–357	**Resistor**, 52.3kΩ, 1/8W, 1%, RN55C		2
R27,28	200054–438	**Resistor**, 365kΩ, 1/8W, 1%, RN55C		1
R29,30	200054–265	**Resistor**, 5.76kΩ, 1/8W, 1%, RN55C		1
R31		(Same as R8)		
R32	200054–222	**Resistor**, 2kΩ, 1/8W, 1%, RN55C		1
U1	202051–000	**IC**, digital, 74HC238, decoder ⚠		1
U2,3	201444–000	**IC**, linear, LM358, dual op amp		1
U4	201641–000	**IC**, digital, 74HC76, J–K flip–flop ⚠		1
X1	200115–007	**Transducer**, audio, piezoelectric		1
2	201773–000	**Rivet**, semi–tubular (used on J7,14)		4

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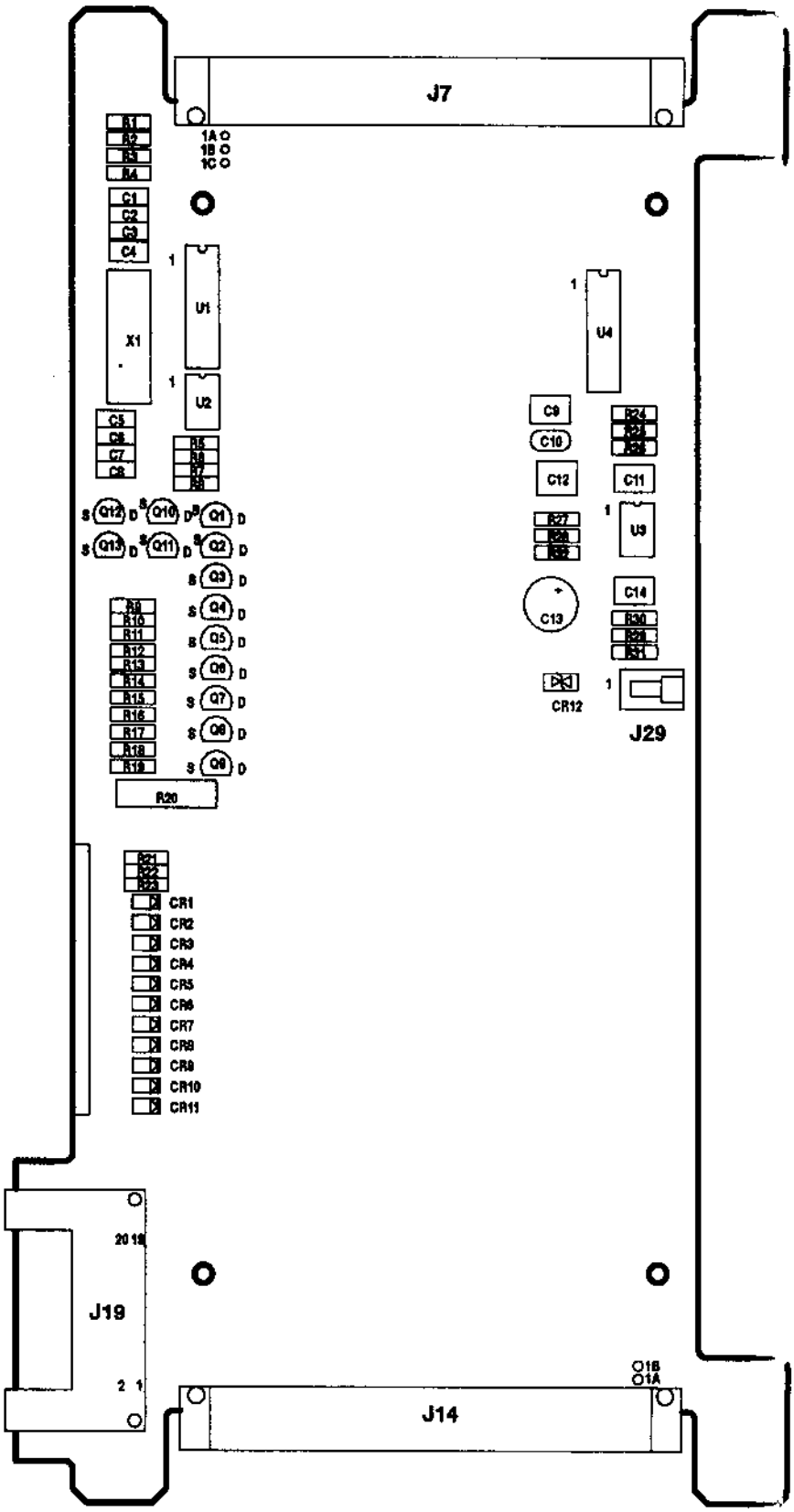

A5

Figure 5–7 Interconnect PCB Assembly
Part Number 803761–00
(Sheet 1 of 3)

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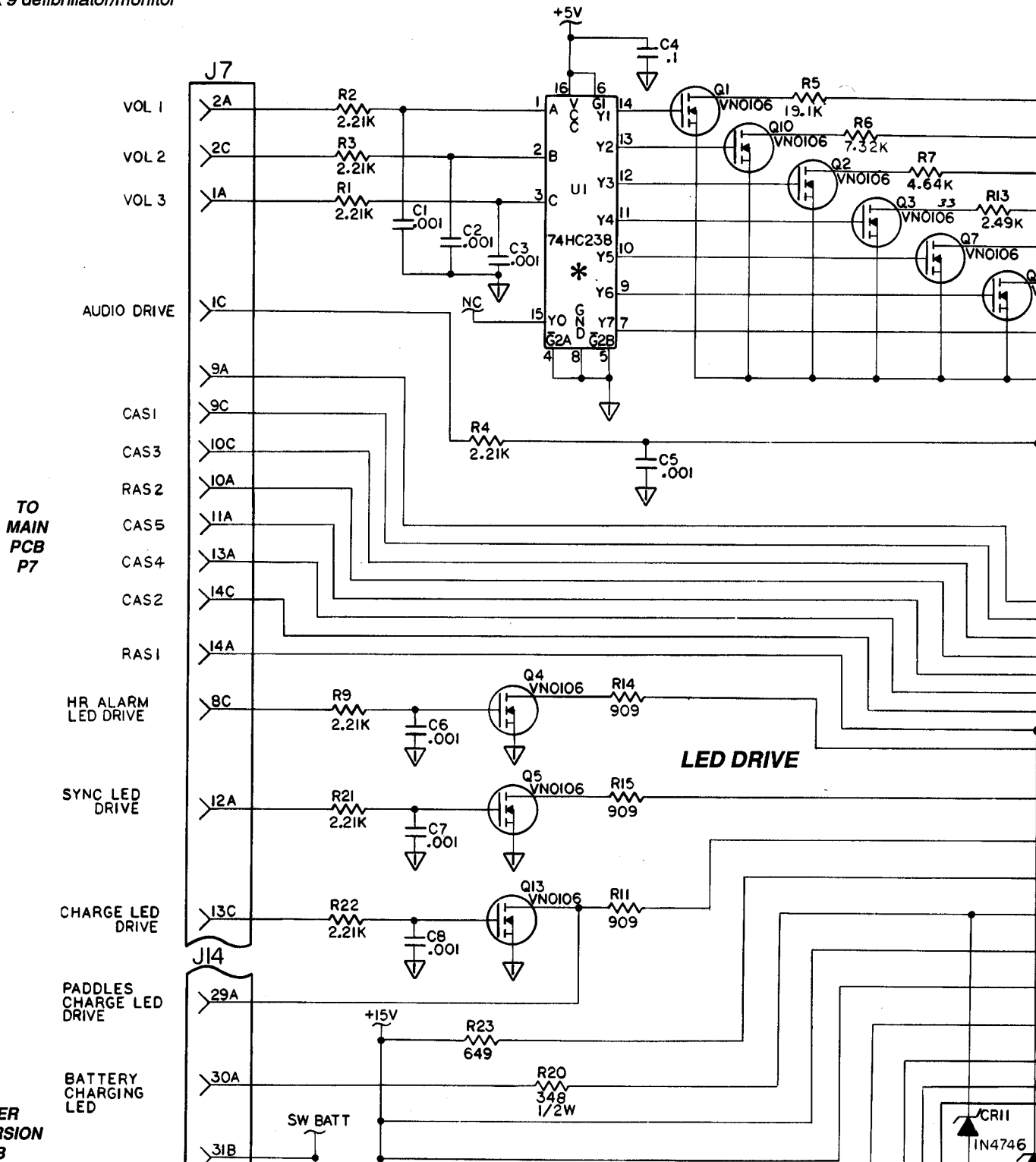
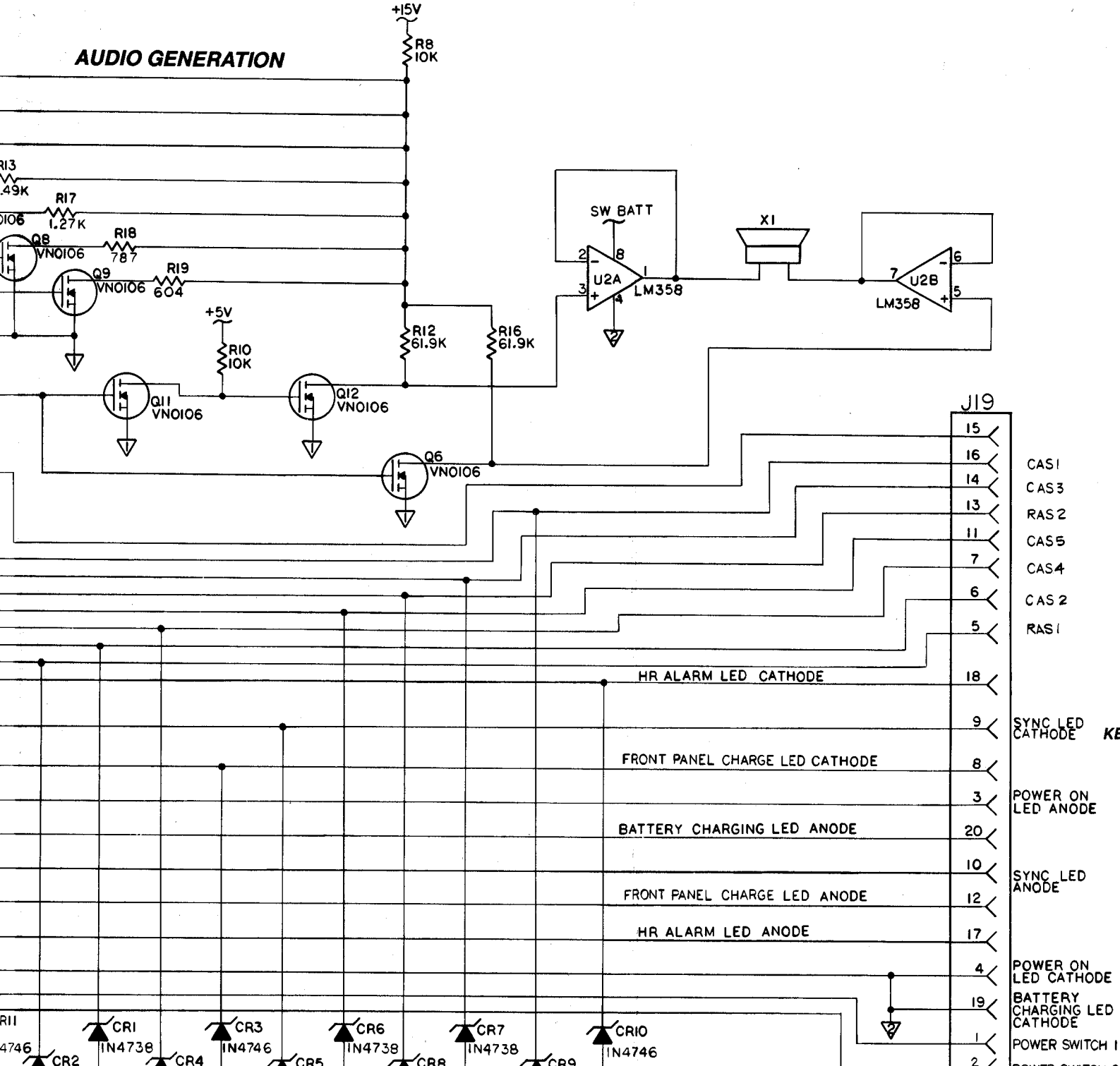
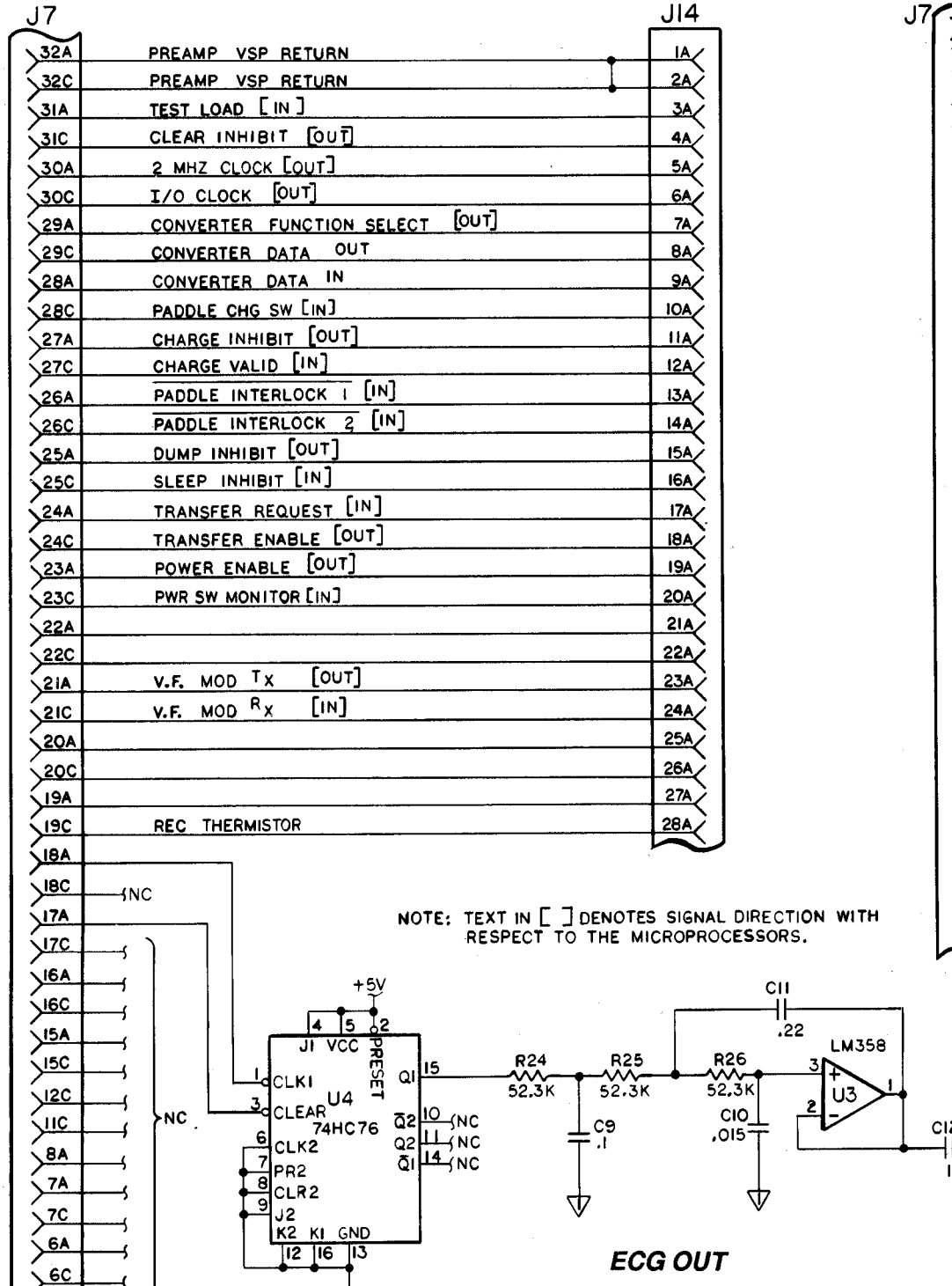
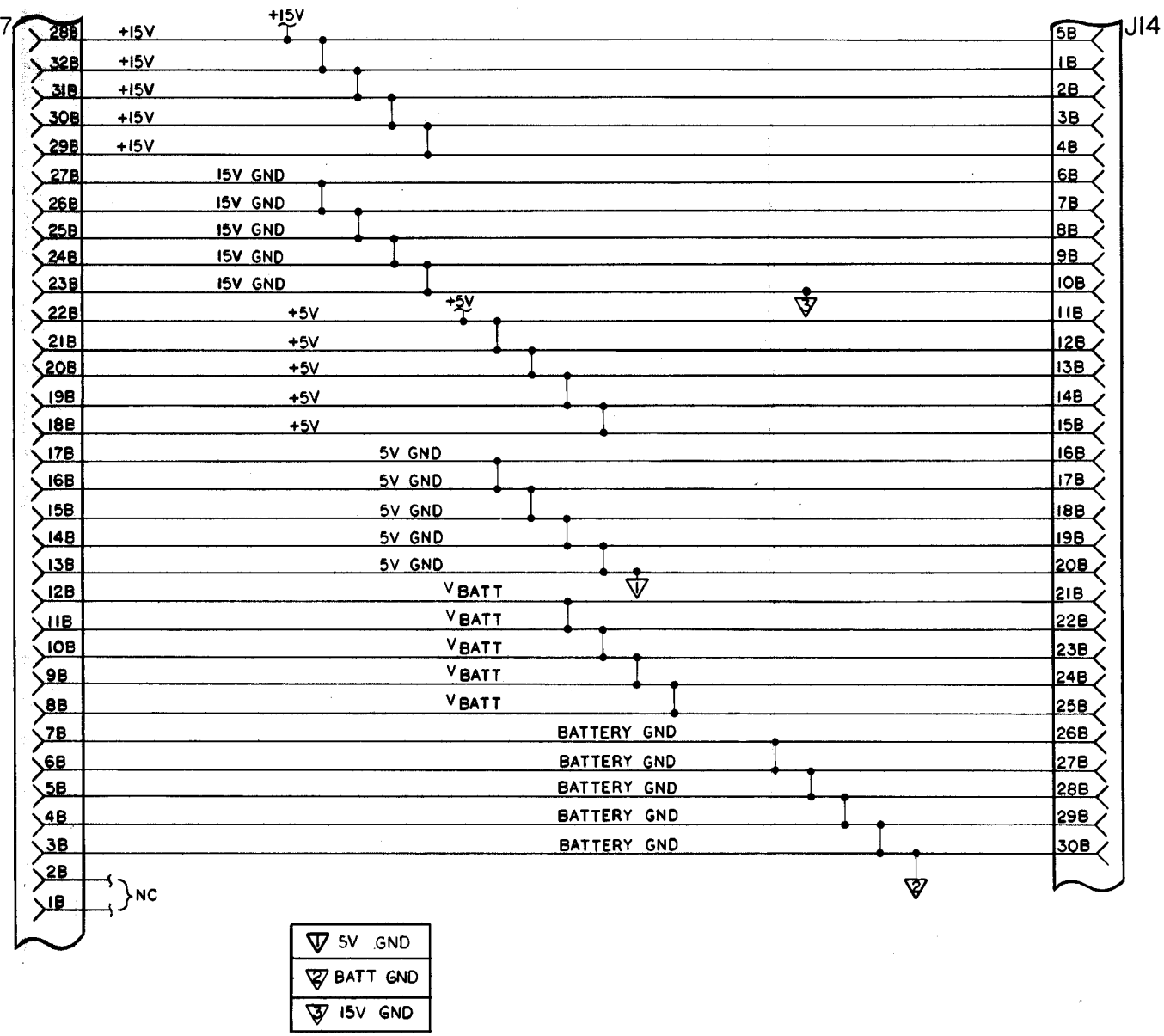
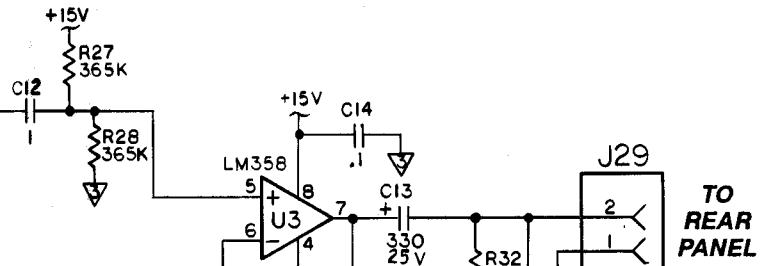

J7
VOL 1
VOL 2
VOL 3
AUDIO DRIVE
CAS1
CAS3
RAS2
CAS5
CAS4
CAS2
RAS1
HR ALARM LED DRIVE
SYNC LED DRIVE
CHARGE LED DRIVE
TO MAIN PCB P7
J14
PADDLES CHARGE LED DRIVE
BATTERY CHARGING LED
TO POWER CONVERSION PCB
+5V
+15V
SW BATT
U1
74HC238
R1 2.21K
R2 2.21K
R3 2.21K
R4 2.21K
R5 19.1K
R6 7.32K
R7 4.64K
R9 2.21K
R11 909
R14 909
R15 909
R20 348 1/2W
R21 2.21K
R22 2.21K
R23 649
C1 .001
C2 .001
C3 .001
C4 .1
C5 .001
C6 .001
C7 .001
C8 .001
Q1 VN0106
Q2 VN0106
Q3 VN0106
Q4 VN0106
Q5 VN0106
Q7 VN0106
Q10 VN0106
Q13 VN0106
RI3 2.49K
CR11 IN4746
LED DRIVE

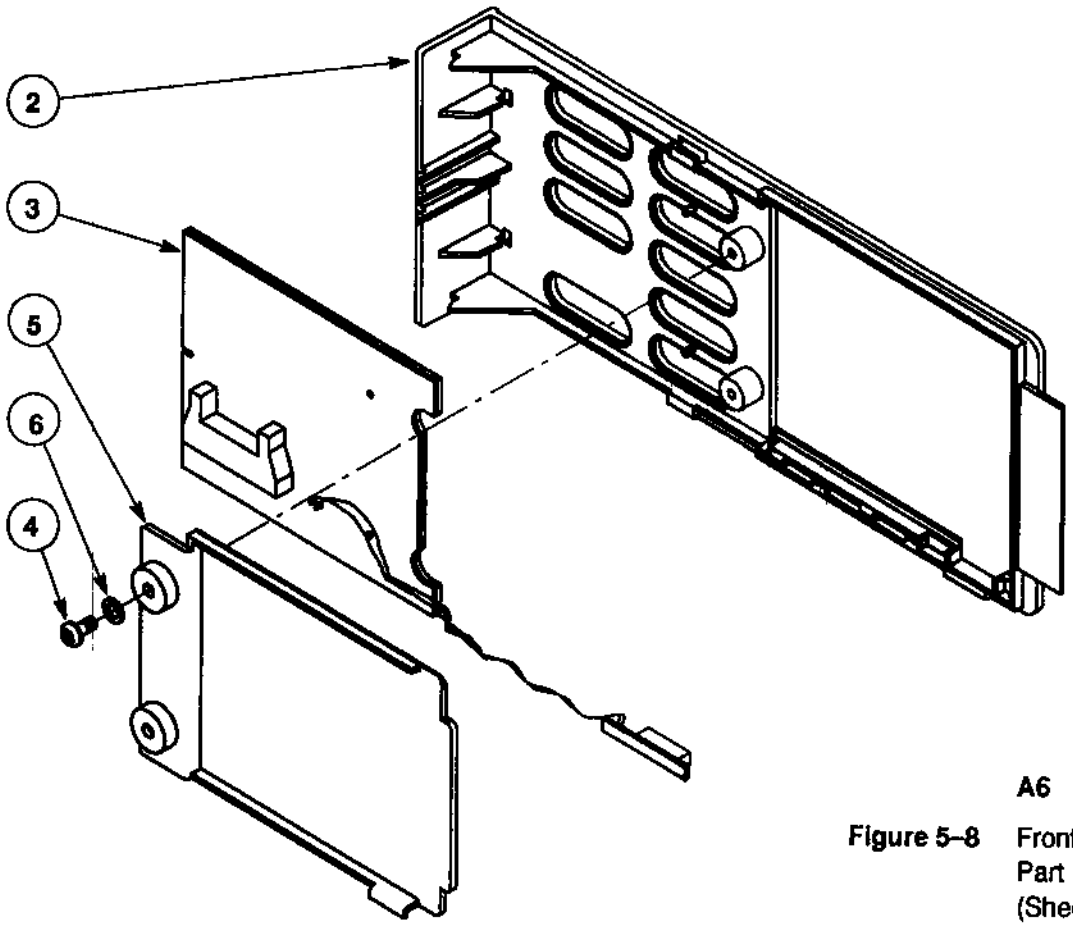

AUDIO GENERATION
+15V
R8
10K
R13
.49K
R17
1.27K
R18
787
R19
604
Q8
VN0106
Q9
VN0106
+5V
R10
10K
R12
61.9K
R16
61.9K
Q11
VN0106
Q12
VN0106
Q6
VN0106
SW BATT
U2A
LM358
X1
U2B
LM358
J19
15
16
CAS1
14
CAS3
13
RAS2
11
CAS5
7
CAS4
6
CAS2
5
RAS1
HR ALARM LED CATHODE
18
9
SYNC LED CATHODE
FRONT PANEL CHARGE LED CATHODE
8
3
POWER ON LED ANODE
BATTERY CHARGING LED ANODE
20
10
SYNC LED ANODE
FRONT PANEL CHARGE LED ANODE
12
HR ALARM LED ANODE
17
4
POWER ON LED CATHODE
19
BATTERY CHARGING LED CATHODE
1
POWER SWITCH I
CR1
IN4738
CR3
IN4746
CR6
IN4738
CR7
IN4738
CR10
IN4746
CR2
CR4
CR5
CR8
CR9


J7
J14
32A PREAMP VSP RETURN 1A
32C PREAMP VSP RETURN 2A
31A TEST LOAD [IN] 3A
31C CLEAR INHIBIT [OUT] 4A
30A 2 MHZ CLOCK [OUT] 5A
30C I/O CLOCK [OUT] 6A
29A CONVERTER FUNCTION SELECT [OUT] 7A
29C CONVERTER DATA OUT 8A
28A CONVERTER DATA IN 9A
28C PADDLE CHG SW [IN] 10A
27A CHARGE INHIBIT [OUT] 11A
27C CHARGE VALID [IN] 12A
26A PADDLE INTERLOCK 1 [IN] 13A
26C PADDLE INTERLOCK 2 [IN] 14A
25A DUMP INHIBIT [OUT] 15A
25C SLEEP INHIBIT [IN] 16A
24A TRANSFER REQUEST [IN] 17A
24C TRANSFER ENABLE [OUT] 18A
23A POWER ENABLE [OUT] 19A
23C PWR SW MONITOR [IN] 20A
22A 21A
22C 22A
21A V.F. MOD Tx [OUT] 23A
21C V.F. MOD Rx [IN] 24A
20A 25A
20C 26A
19A 27A
19C REC THERMISTOR 28A
18A
18C NC
17A
17C
16A
16C
15A
15C
12C
11C
NC
8A
7A
7C
6A
6C
NOTE: TEXT IN [ ] DENOTES SIGNAL DIRECTION WITH RESPECT TO THE MICROPROCESSORS.
+5V
J1 VCC
PRESET
CLK1
CLEAR
CLK2
PR2
CLR2
J2
K2 KI GND
U4
74HC76
Q1
Q2
Q2
Q1
NC
NC
NC
R24 52.3K
R25 52.3K
R26 52.3K
C9 .1
C10 .015
C11 .22
LM358
U3
ECG OUT


J14
+15V
+5V
5V GND
VBATT
BATTERY GND
15V GND
NC
5V GND
BATT GND
15V GND


+15V
R27
365K
C12
R28
365K
LM358
U3
C14
C13
330
25V
R32
J29
TO
REAR
PANEL

5–8 Ref	Part Number	Description	Use Code	Qty
A6	**803745–00**	**Front Panel Assembly**, English	A	REF
	803745–01	**Front Panel Assembly**, French	B	REF
	803745–02	**Front Panel Assembly**, German	C	REF
	803745–03	**Front Panel Assembly**, Spanish	D	REF
	803745–04	**Front Panel Assembly**, Portuguese	E	REF
	803745–05	**Front Panel Assembly**, Italian	F	REF
	803745–06	**Front Panel Assembly**, Swedish	G	REF
2	803744–00	**Bezel**		1
3	803771–01	**Keypad Assembly**, English	A	1
	803771–02	**Keypad Assembly**, French	B	1
	803771–03	**Keypad Assembly**, German	C	1
	803771–04	**Keypad Assembly**, Spanish	D	1
	803771–05	**Keypad Assembly**, Portuguese	E	1
	803771–06	**Keypad Assembly**, Italian	F	1
	803771–07	**Keypad Assembly**, Swedish	G	1
4	201874–012	**Screw**, pan–head, 8–32 x 0.375 L		5
5	803770–01	**Shield**, CRT implosion		1
6	200804–101	**Washer**, flat, #8		3



A6

Figure 5–8 Front Panel ... Part Numb... (Sheet 1 of ...

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5–9 Ref	Part Number	Description	Use Code	Qty
	803771–01	Keypad Assembly, English (part of A6, Front Panel Assembly)		REF
	803771–02	Keypad Assembly, French		REF
	803771–03	Keypad Assembly, German		REF
	803771–04	Keypad Assembly, Spanish		REF
	803771–05	Keypad Assembly, Portuguese		REF
	803771–06	Keypad Assembly, Italian		REF
	803771–07	Keypad Assembly, Swedish		REF

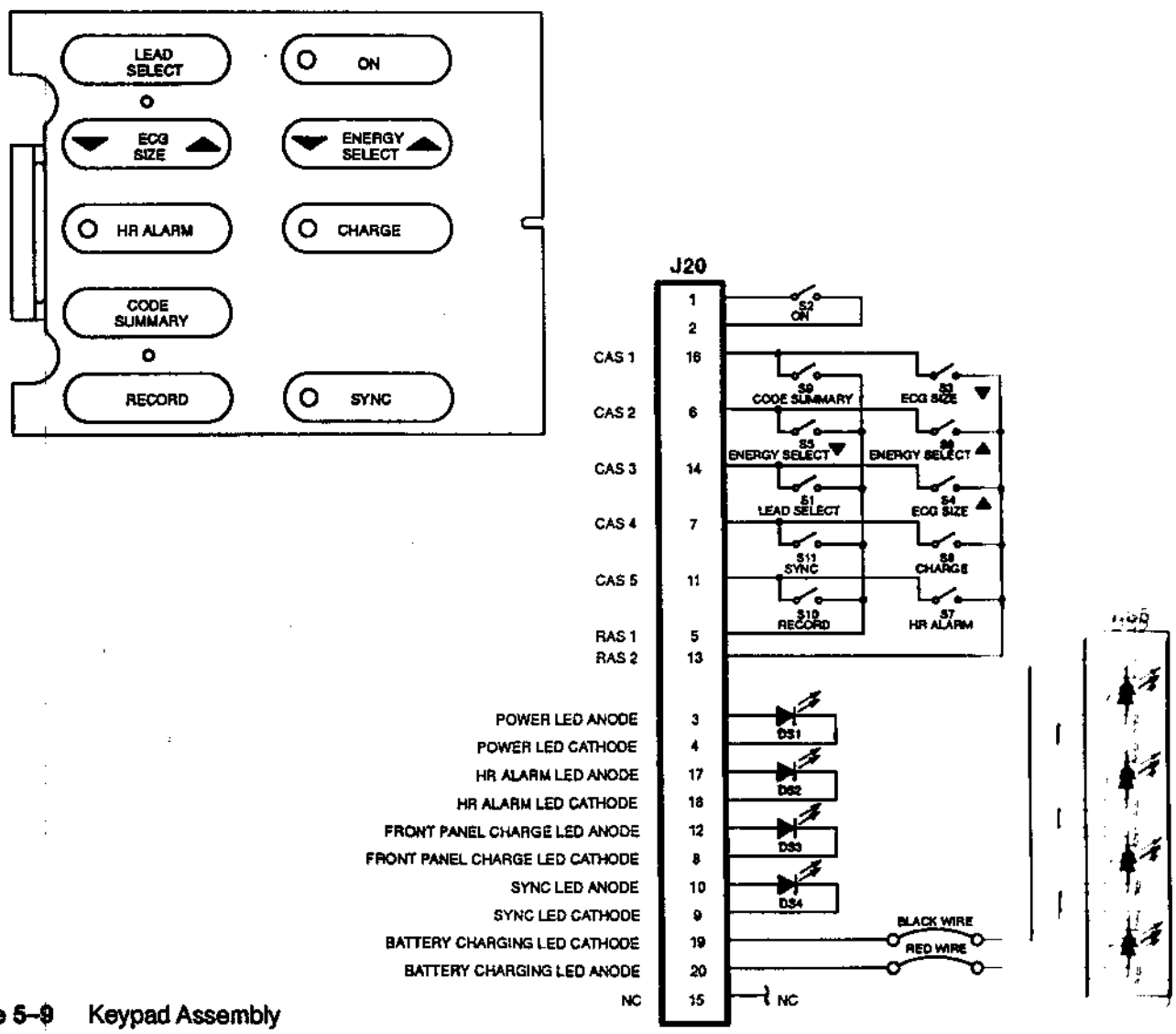

Figure 5–9 Keypad Assembly
Part Number 803771
(Sheet 1 of 1)

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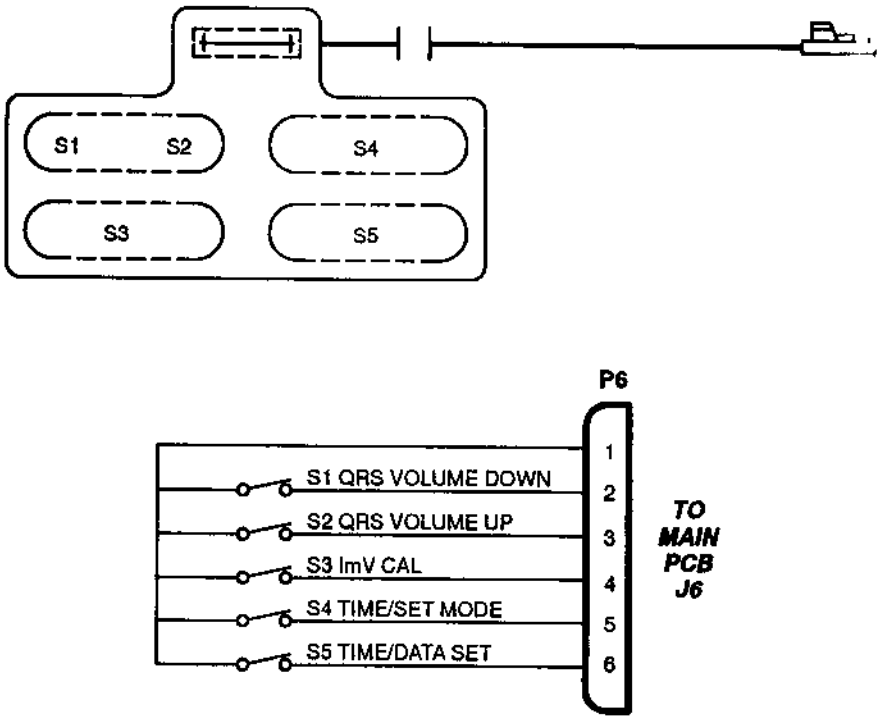
5–10 Ref	Part Number	Description	Use Code	Qty REF
A7	803741–01	Rear Panel Membrane Switch		



A12

Figure 5–10 Rear Panel Membrane Switch
Part Number 803741–01
(Sheet 1 of 1)

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5–11 Ref	Part Number	Description	Use Code	Qty
A8	804189–00	**Strip Chart Recorder Assembly, GSI**		REF
2	GSI624–10256	**Base**, chassis		1
3	GSI624–11759	**Bracket Mod**, printhead (pre–assembled at GSI)*		1
4	GSI624–10278	**Bracket**, pivot head		1
5	GSI624–10253	**Bumper**, printhead		2
6	GS1624–10270	**Cover**, gear		1
7	GSI624–10254	**Door**, chassis		1
8	GSI624–10260	**Ejector Assembly**, paper		1
9	GSI625–10268	**Gear**, idler 108T		1
10	GSI625–10266	**Gear**, motor 15T		1
11	GSI625–10267	**Gear**, motor 31T		1
12	GSI624–10224	**Keyshim Gear**		1
13	GSI624–10225	**Label**, paper feed		1
14	GSI624–10255	**Latch**, chassis		1
15	GSI624–10257	**Link**, latch plate		1
16	GSI624–10258	**Link**, printhead		1
17	GSI610–102341	**Motor Assembly/Gear**		1
18	GSI420–06175	**Nameplate**, label		1
19	GSIR52–41003	**O–Ring**, IB Moore #2–104		1
20	GSIR75–00007	**Printhead**, KST 488MPDI (pre–assembled at GSI)*		1
21	GSI615–200051	**Printroller Assembly**		1
22	GSIR5E–513	**Ring**, rtng TRU 5100–18		1
23	GSIR5E–519	**Ring**, rtng TRU 5133–9		1
24	GSIR41–22001	**Screw**, flat head, 90 M2, OX, 4 x 6mm		5
25	GSIR42–50083	**Screw**, pan head, 4–40 x 0.25		3
26	GSIR41–50082	**Screw**, pan head		1
27	GSI624–10246	**Shaft**		2
28	GSI625–10263	**Shaft Roller**		1
29	GSI624–10262	**Shaft**, linkage		2
30	GSI620–10244	**Spring**		2
31	GSI615–102331	**Spring Assembly**		1
32	GSI624–11893	**Tubing** (not shown, used on item 17)		n/a
		*Specialized alignment equipment required. Replacement of entire Strip Chart Recorder is recommended.		

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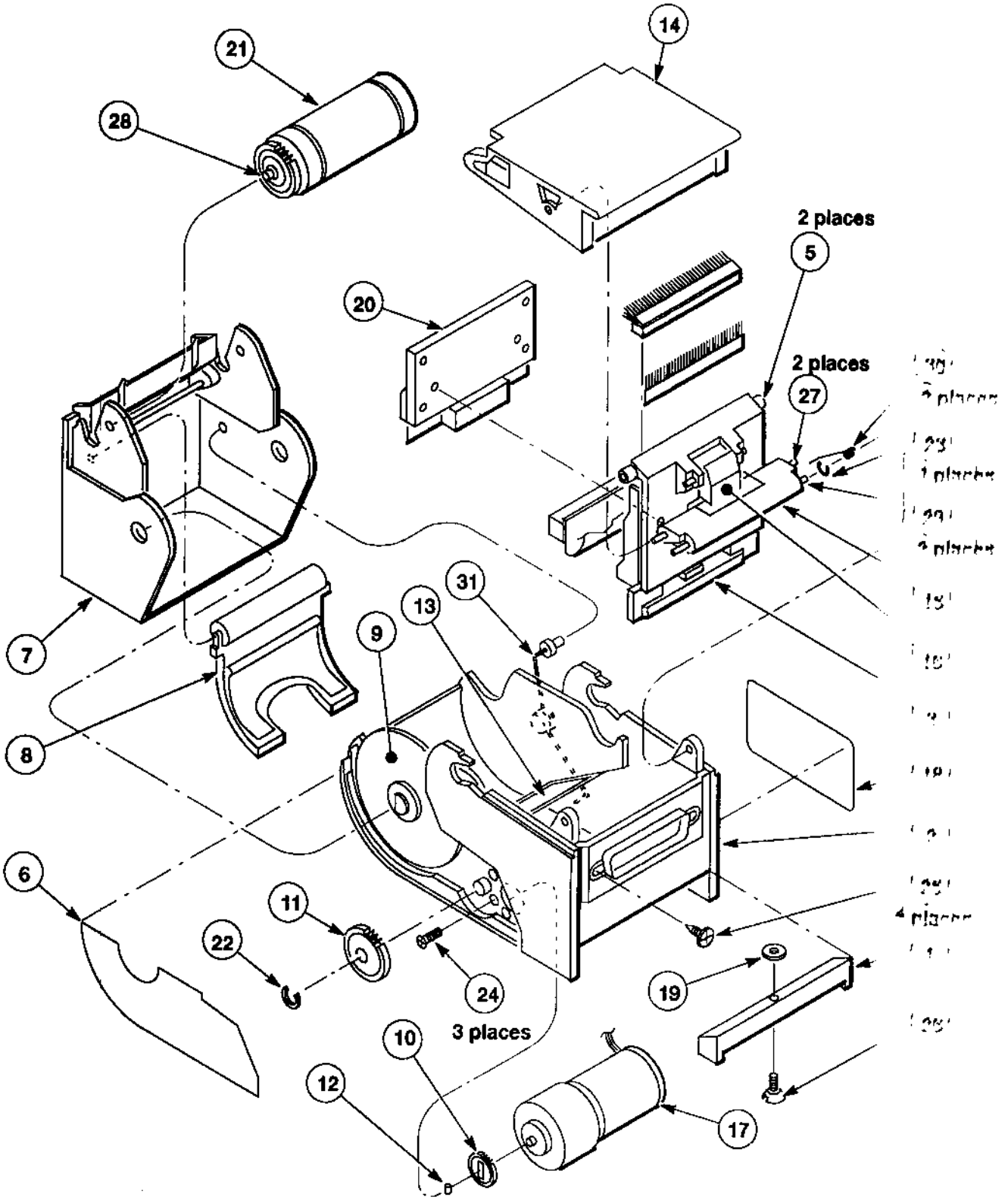

A8

Figure 5–11 Strip Chart Recorder ... Assy
Part Number 804 1...
(Sheet 1 of 2)

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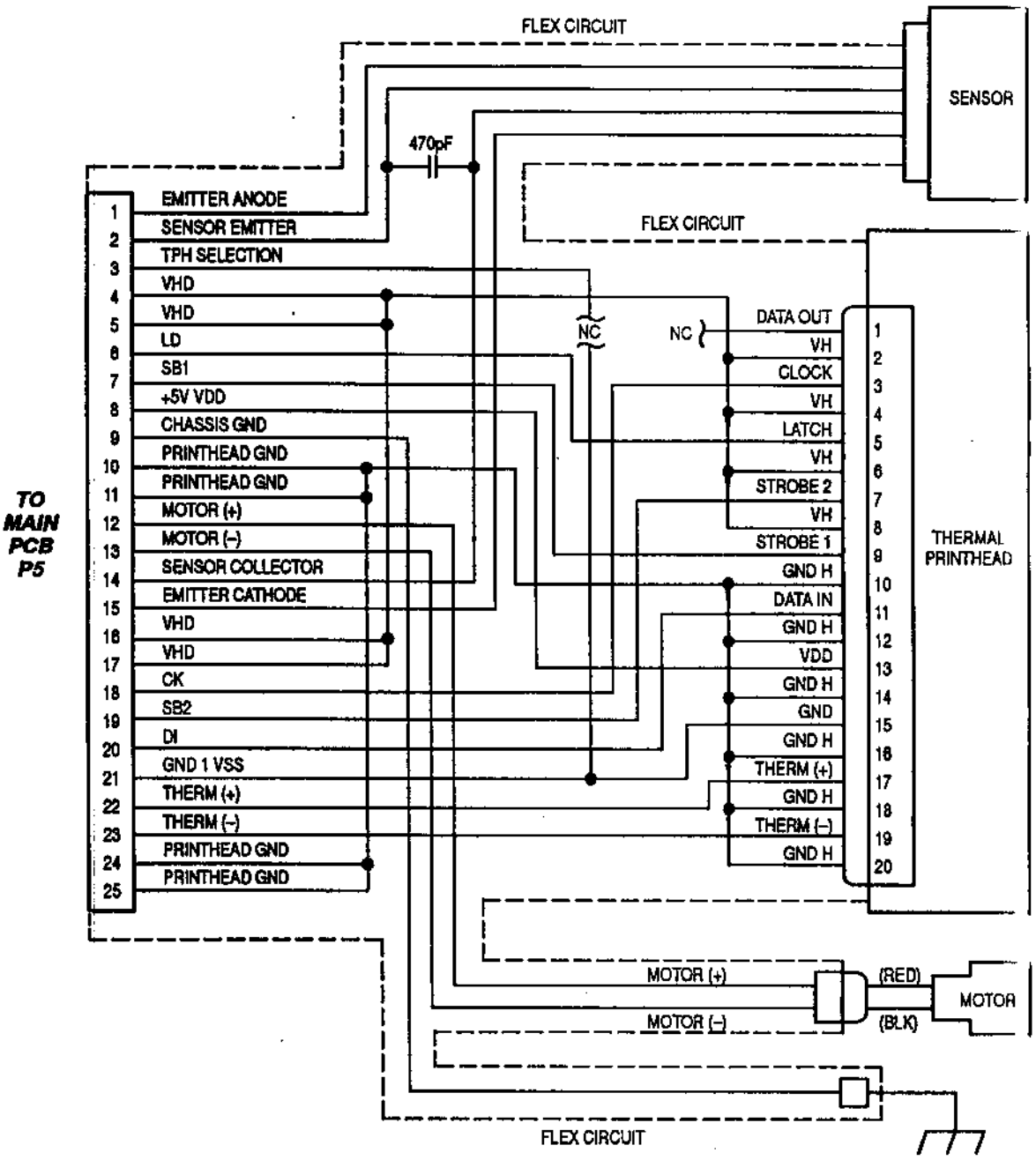

A8

Figure 5–11 Strip Chart Recorder Assembly
Part Number 804189–00
(Sheet 2 of 2)

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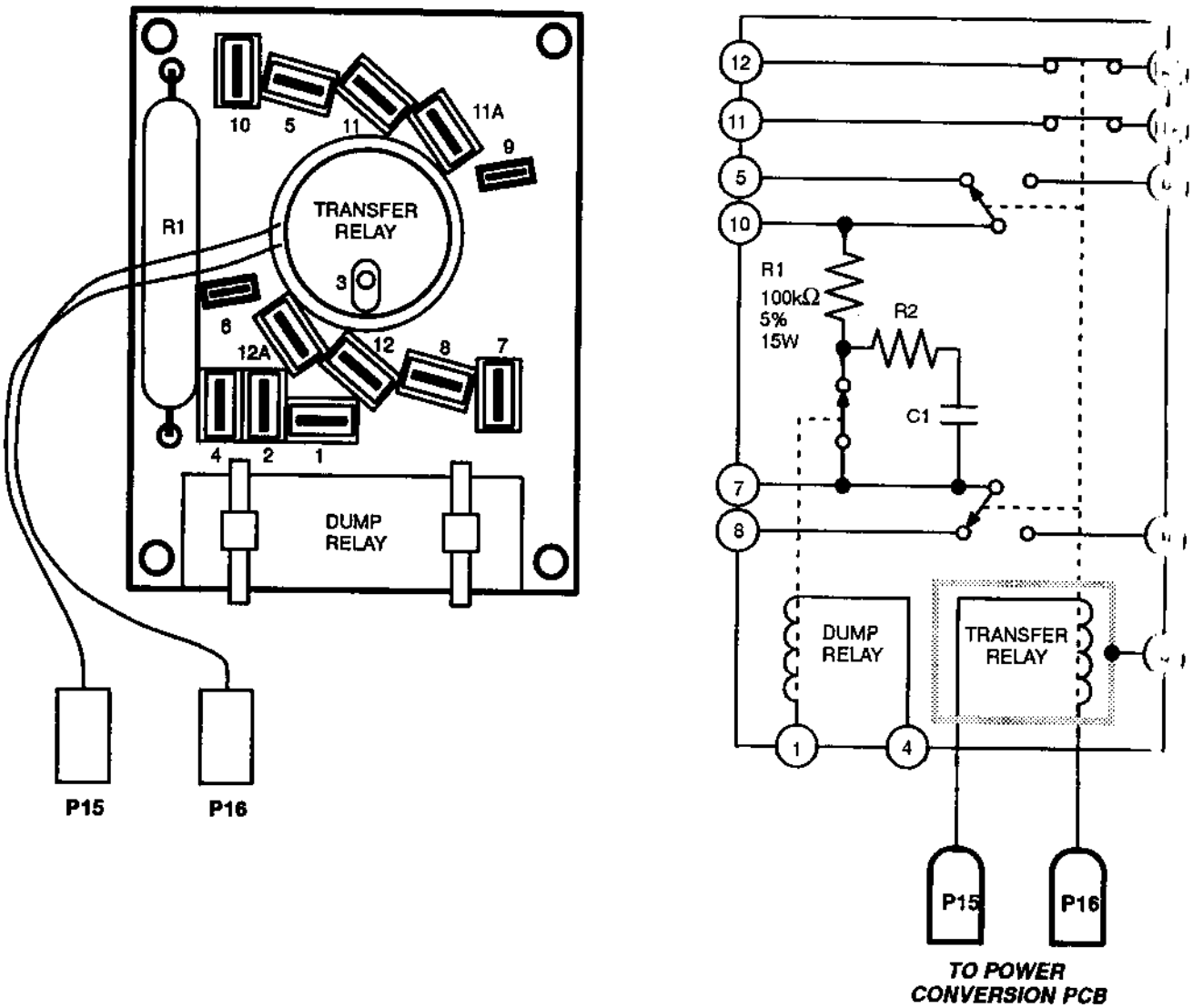
5–12 Ref	Part Number	Description	Use Code	Qty
A9	800240–11	Transfer Relay Assembly		PFF



A9

Figure 5–12 Transfer Relay Assembly Part Number 800240-11 (Sheet 1 of 1)

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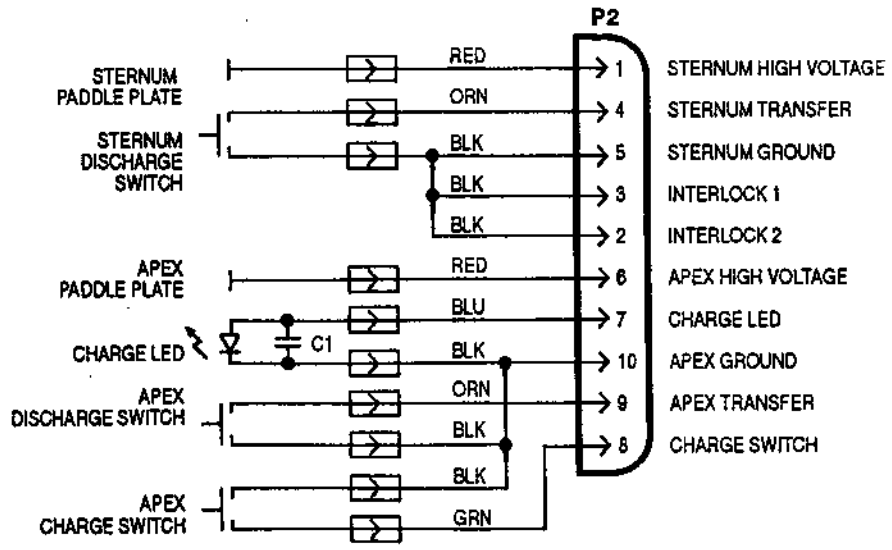
5–13 Ref	Part Number	Description	Use Code	QTY
A10	**802901–06**	**Paddle Assembly**		REF
2	202221–00	**Adhesive**, hot melt, thermoplastic (not shown, used on item 8)		AR
3	802930–06	**Base**, apex paddle		1
	802930–05	**Base**, sternum paddle		1
4	803728–01	**Cord Assembly**, terminated, high voltage		1
5	802934–04	**Cover**, apex paddle		1
	802934–05	**Cover**, sternum paddle		1
6	802902–02	**Electrode Plate Assembly**, apex paddle		1
	802902–03	**Electrode Plate Assembly**, sternum paddle		1
7	802944–00	**Gasket**, paddle		2
8	802931–00	**Handle**, apex paddle (label not shown, see Figure 5–1)		1
	802931–01	**Handle**, sternum paddle (label not shown, see Figure 5–1)		1
9	802932–00	**Key**, retainer, coil cord		4
10	800819–01	**Label**, serial number (not shown)		1
11	200491–048	**LED**, panel mount (on apex paddle only)		1
12	201508–004	**Nut**, lock, kep, 8–32 x 0.312/0.100 T		6
13	201103–537	**Screw**, pan head, black oxide, 4–40 x 0.312 L		17
14	804231–00	**Shield**, high voltage		4
15	804697–03	**Switch**, SPST (pushbutton not shown, see Figure 5–1)		3
16	200283–005	**Tubing**, heat shrink, red, 0.250 ID (on apex paddle only)		AR



A10

Figure 5–13 Paddle Assembly
Part Number 802901–06
(Sheet 1 of 2)

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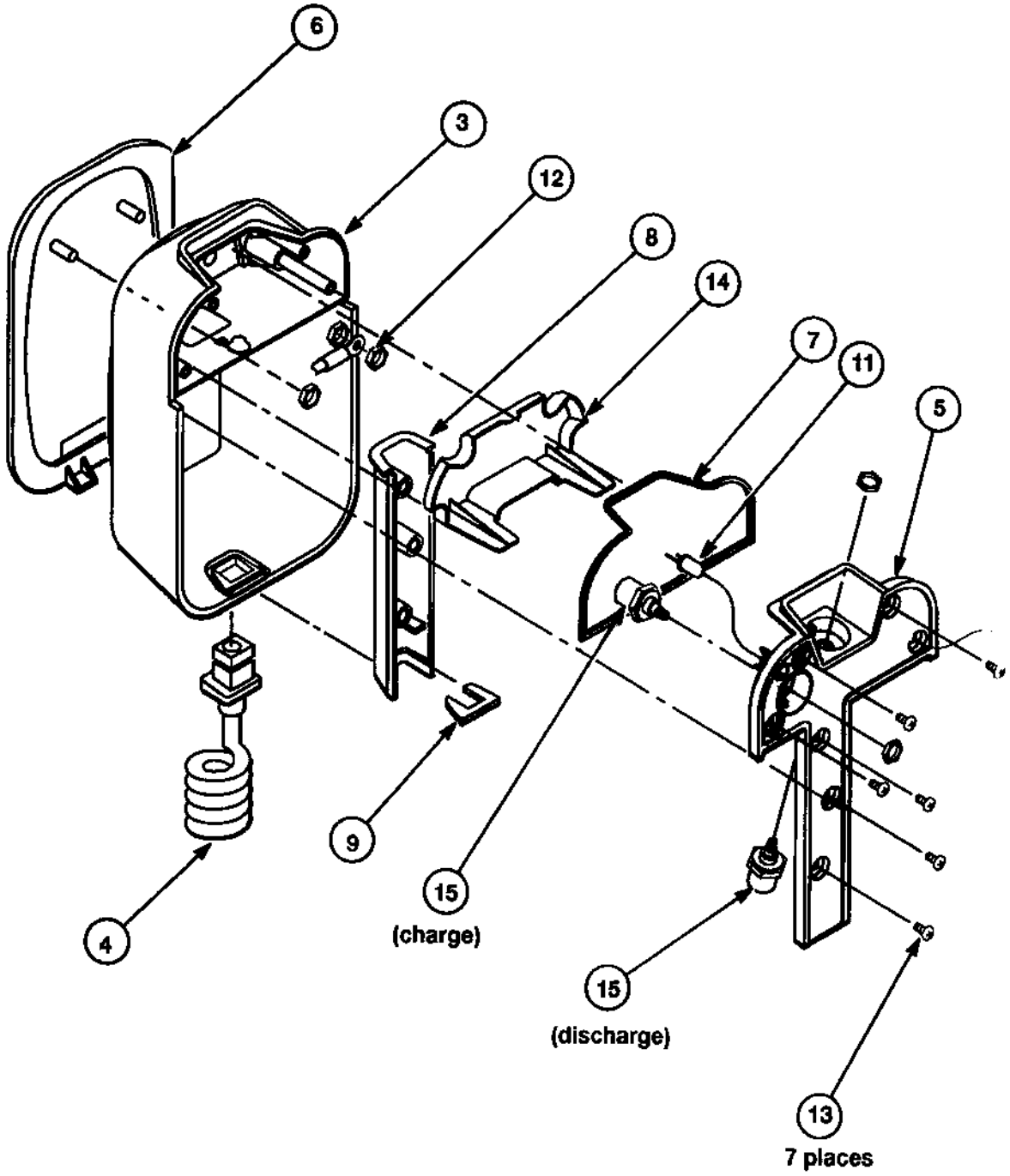

A10

Figure 5–13 Paddle Assembly
Part Number ...
(Sheet 2 of 2)

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5–14 Ref	Part Number	Description	Use Code	Qty
W1	**803783–18**	**Power Supply PCB/AC Receptacle/Ground Wire Harness**		REF
L, N	200267–026	**Terminal**, receptacle, insulated, 22–18 AWG		2
P1	202151–056	**Connector**, housing, 18 AWG, 6 contact		1
2	202151–117	**Cover**, housing, strain relief, 6 contact		2
3	202151–500	**Plug**, keying		1
4	200536–001	**Retainer**, cable tie, nylon, 0.1 W x 4 L		2
5	200276–212	**Terminal**, lug, ring tongue, 22–16 AWG		1
6	200283–018	**Tubing**, heat shrink, black, 0.187 ID		A/R
7	201756–016	**Tubing**, PVC, clear, 0.166 ID		A/R
8	201535–084	**Wire**, semirigid, PVC, 300V, 18 AWG, blue		A/R
9	201535–080	**Wire**, semirigid, PVC, 300V, 18 AWG, brown		A/R
10	201535–090	**Wire**, semirigid, PVC, 300V, 18 AWG, green/yellow		A/R

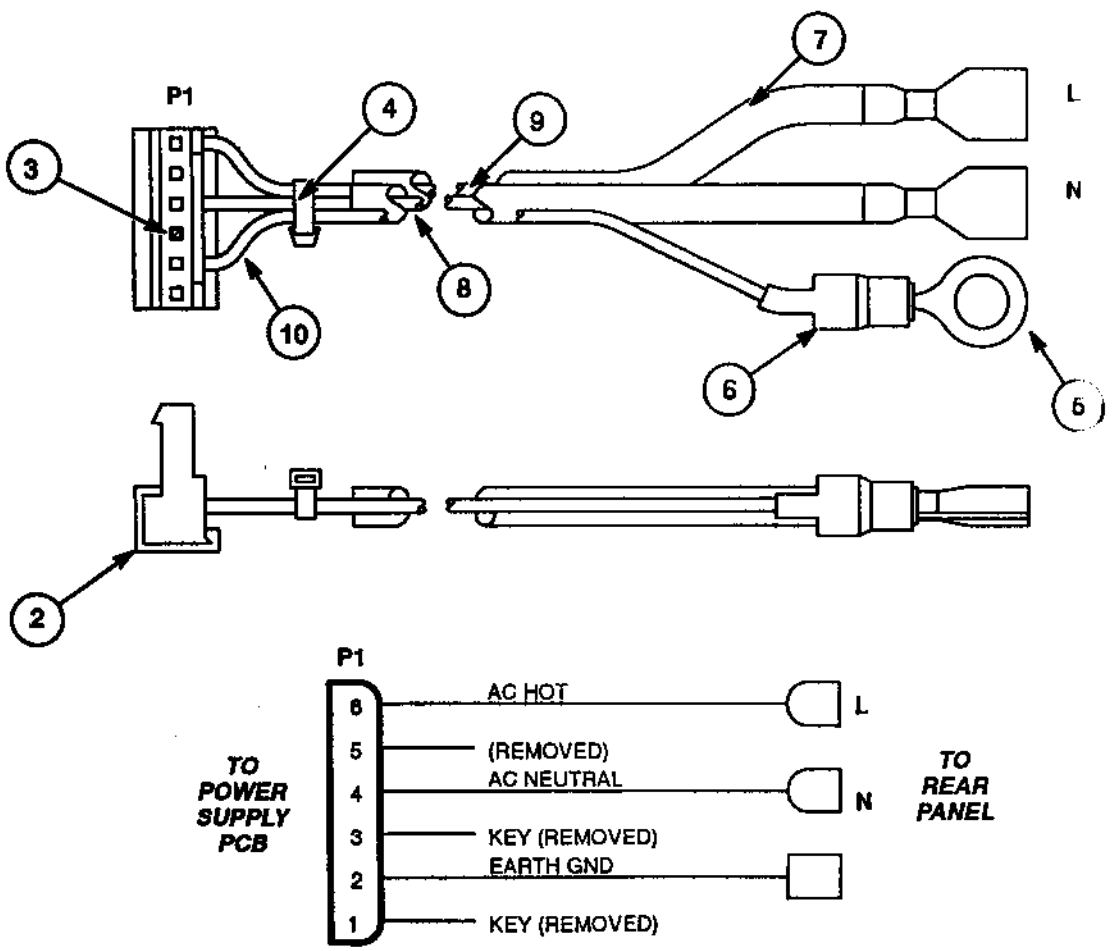

Figure 5–14 Power Supply PCB/AC Receptacle/ Ground Wire Harness

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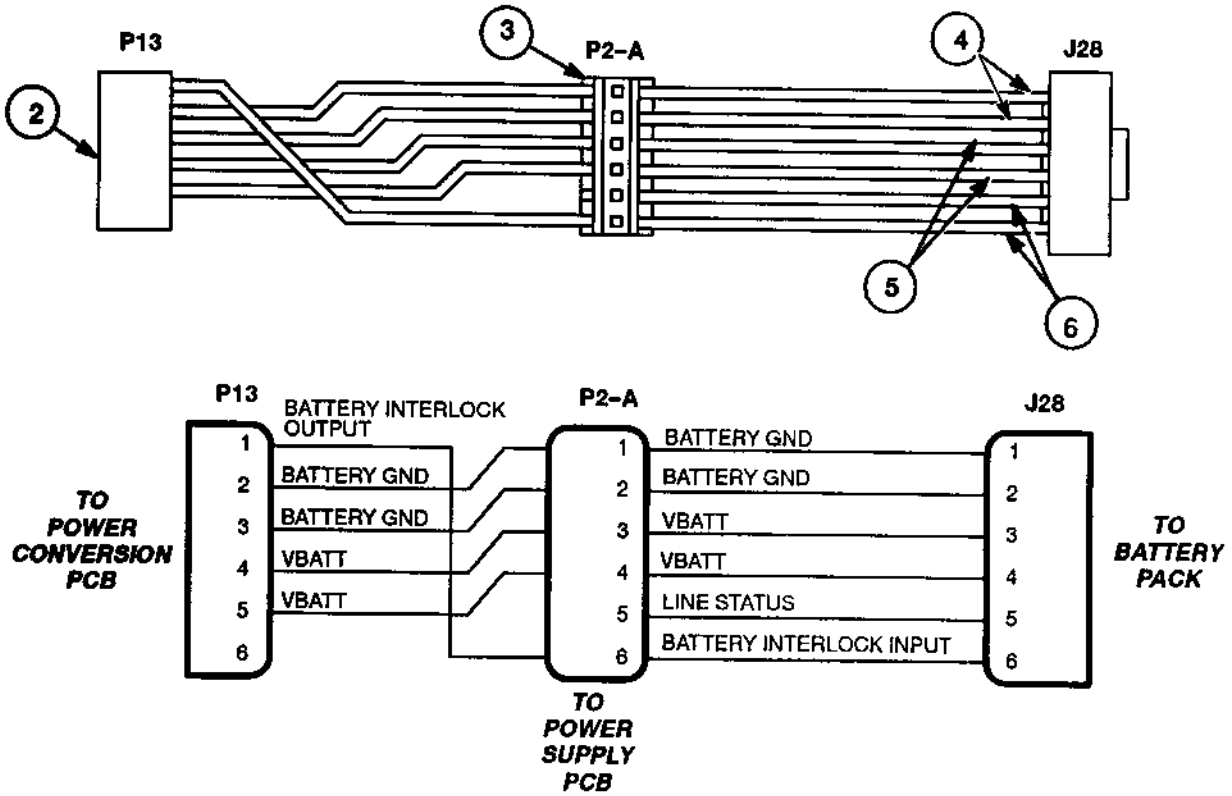
5–15 Ref	Part Number	Description	Use Code	Qty
W2	**803783–23**	**Power Conversion PCB/Power Supply PCB/Battery Wire Harness**		**REF**
J28	202151–335	**Connector**, cable, 18 AWG, 6 contact		1
P2–A	202151–425	**Connector**, housing, feed–thru, 6 contact		1
P13	202151–056	**Connector**, housing, 18 AWG, 6 contact		1
2	202151–117	**Cover**, housing, strain relief, 6 contact		2
3	202151–436	**Cover**, housing, feed–thru, 6 contact		1
4	201535–078	**Wire**, semirigid, PVC, 300V, 18 AWG, black		A/R
5	201535–079	**Wire**, semirigid, PVC, 300V, 18 AWG, red		A/R
6	201535–087	**Wire**, semirigid, PVC, 300V, 18 AWG, white		A/R



W2

Figure 5–15 Power Conversion PCB/Power Supply PCB/Battery Wire Harness

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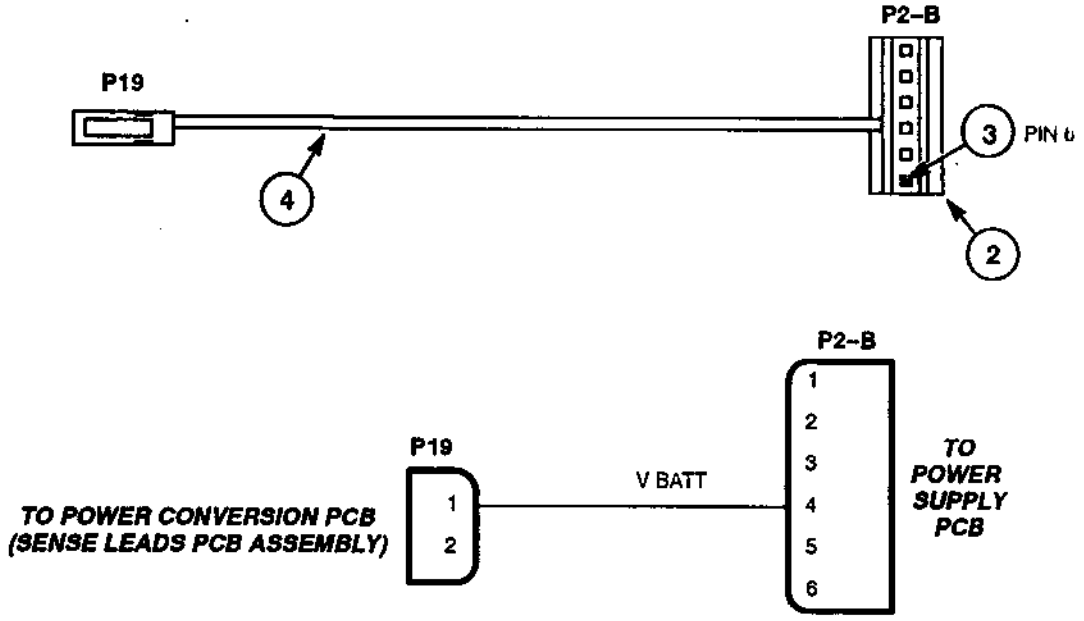
5–16 Ref	Part Number	Description	Use Code	Qty
W3	**803783–24**	**Battery Sensor/Power Supply PCB Wire Harness**		REF
P2–B	202151–030	**Connector**, housing, 22 AWG, 6 contact		1
P19	202125–024	**Receptacle Assembly**, single row, 2 contact		1
2	202151–117	**Cover**, housing, strain relief, 6 contact		1
3	202151–500	**Plug**, keying		1
4	201535–019	**Wire**, semirigid, PVC, 300V, 22 AWG, red		A/R



W3

Figure 5–16 Battery Sensor/Power Supply PCB Wire Harness

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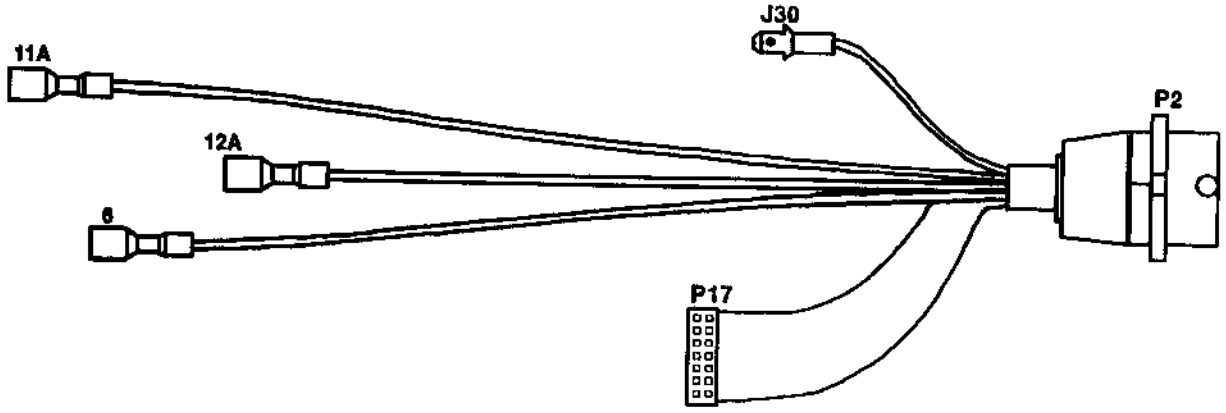
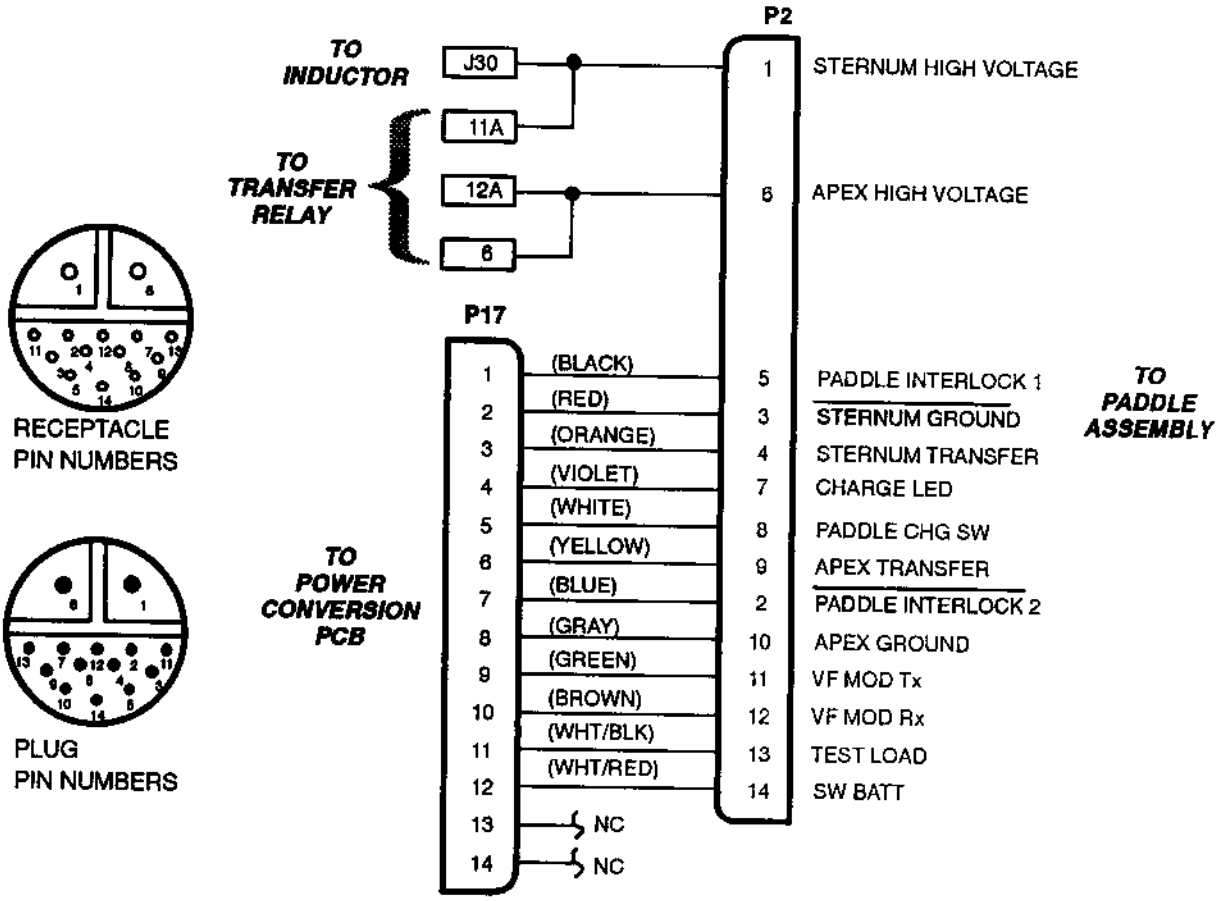
5–17 Ref	Part Number	Description	Use Code	Qty
W4	803756–13	High Voltage Connector Cable Assembly		REF





W4

Figure 5–17 High Voltage Connector Cable Assembly

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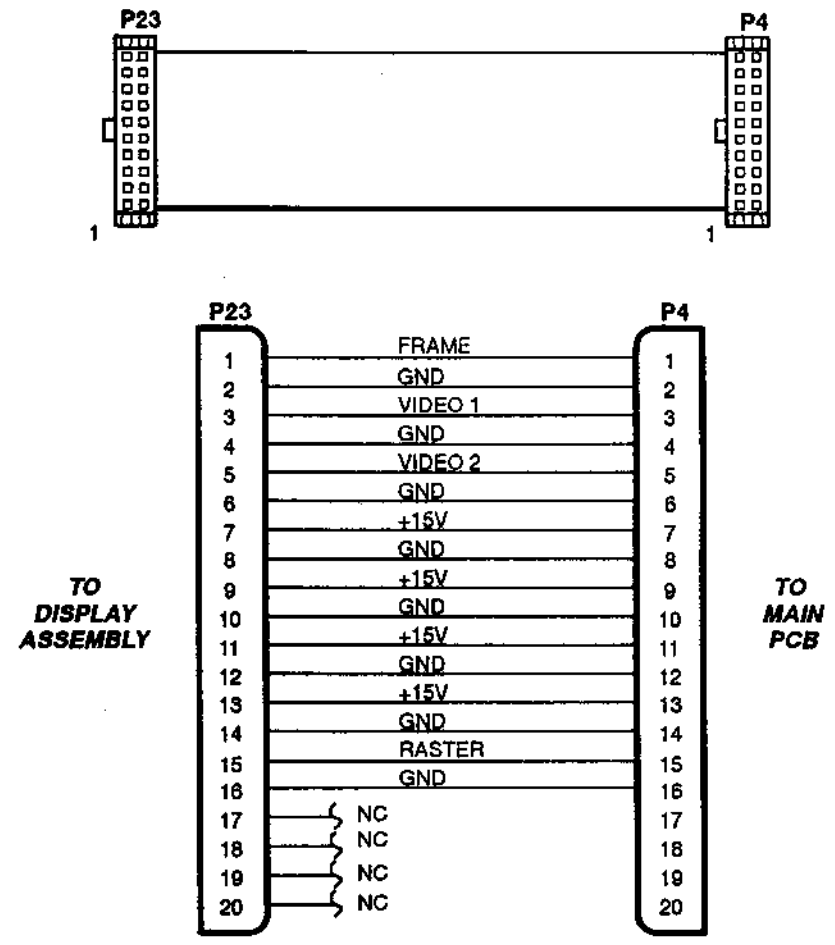
5–18 Ref	Part Number	Description	Use Code	Qty
W5	803733–00	Main PCB/Display Cable Assembly		REF



W5

Figure 5–18 Main PCB/Display Cable Assembly

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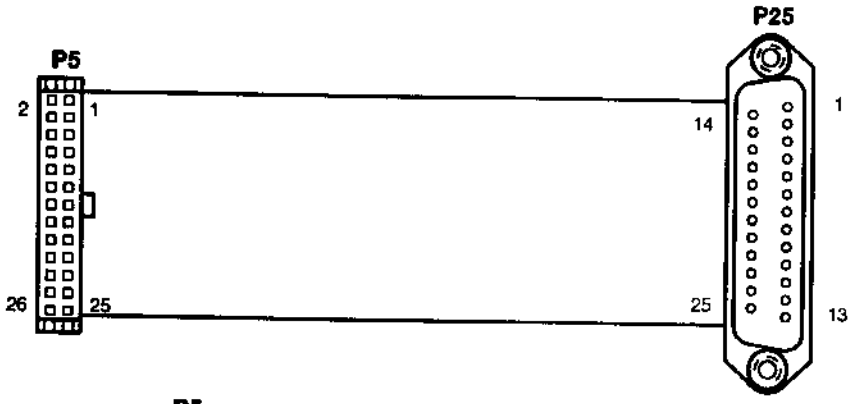
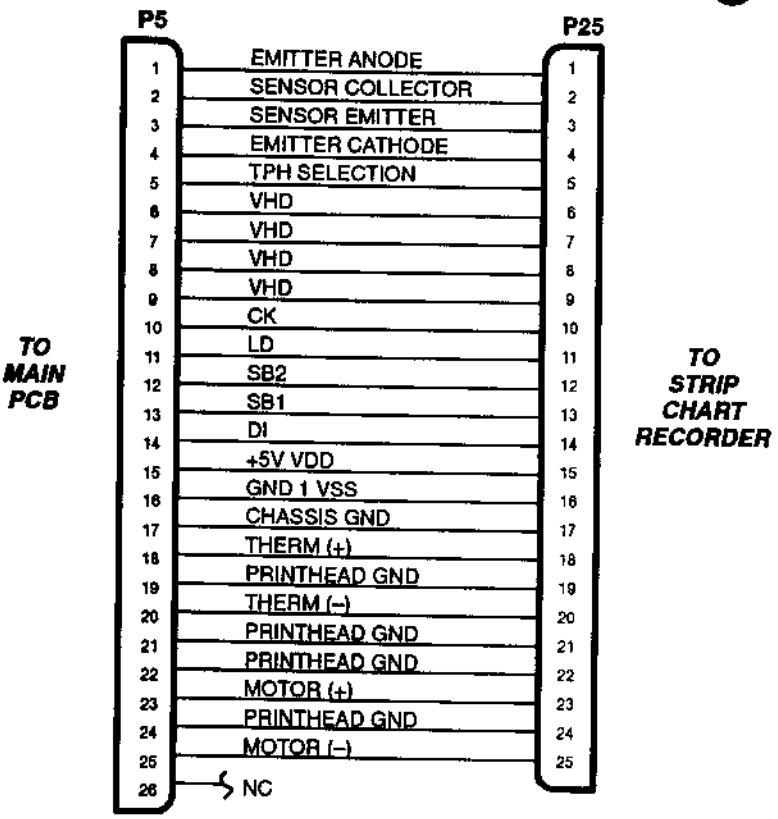
5–19 Ref	Part Number	Description	Use Code	Qty
W6	803773–00	Main PCB/Recorder Cable Assembly		1





W6

Figure 5–19 Main PCB/Recorder Cable Assembly

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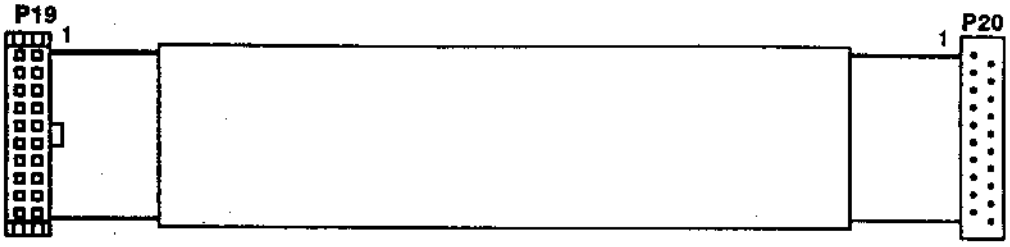
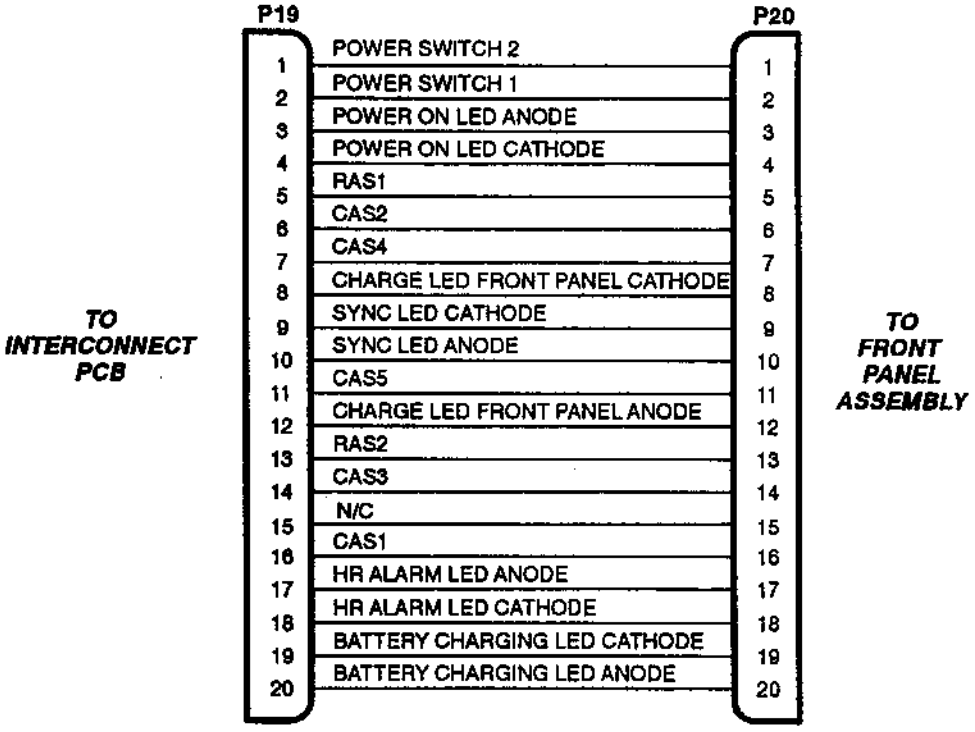
5–20 Ref	Part Number	Description	Use Code	Qty
W7	803772–00	Interconnect PCB/Front Panel Cable Assembly		REF





W7

Figure 5–20 Interconnect PCB/Front Panel Cable Assembly

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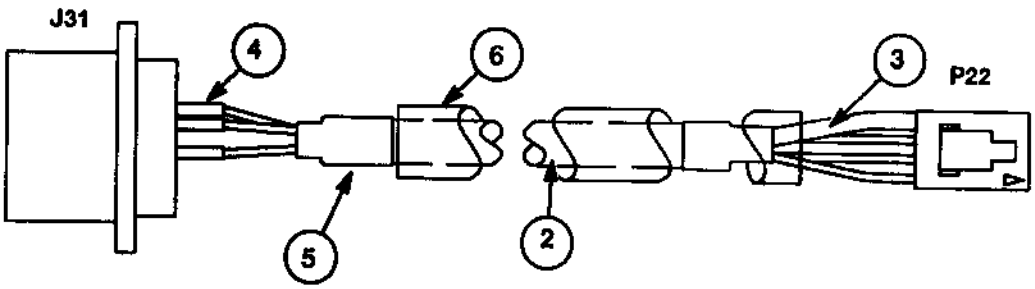
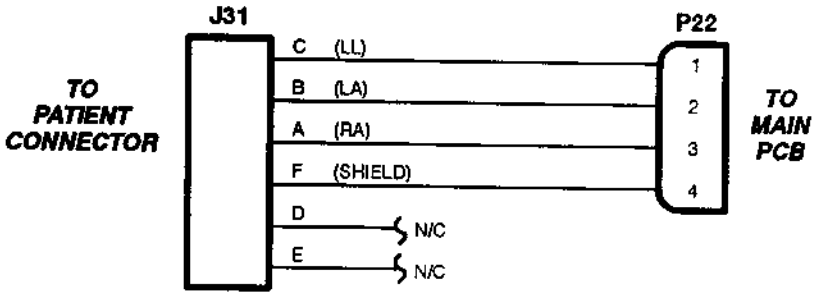
5–21 Ref	Part Number	Description	Use Code	Qty
W8	**803783–00**	**Main PCB/Patient Connector Wire Harness**		Ref
J31	801050–00	**Connector**, circular, chassis		1
P22	202125–026	**Receptacle**, 4 contact		1
2	200734–001	**Cable**, shield, stranded, 24 AWG, 300V, CSA		A/R
3	200283–014	**Tubing**, heat shrink, black, 0.046 ID		A/R
4	200283–017	**Tubing**, heat shrink, black, 0.125 ID		A/R
5	200283–018	**Tubing**, heat shrink, black, 0.187 ID		A/R
6	201756–020	**Tubing**, PVC, clear, 0.263 ID		A/R





W8

Figure 5–21 Main PCB/PatientCon... Wire Harness

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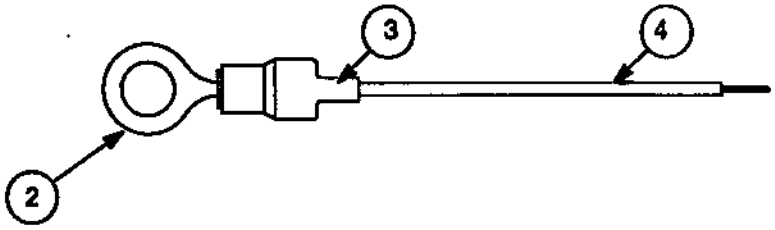
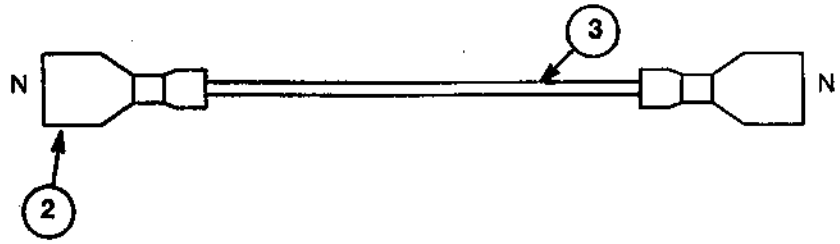
5–22 Ref	Part Number	Description	Use Code	Qty
W9	**803783–04**	**AC Receptacle/Ground Wire Harness**		REF
2	200276–212	**Terminal**, lug, 22–16 AWG		1
3	200283–018	**Tubing**, heat–shrink, black, 0.187 ID		A/R
4	201535–090	**Wire**, semirigid, PVC, 300V, 18 AWG, green/yellow		A/R



W9

Figure 5–22 AC Receptacle/Ground Wire Harness

5–23 Ref	Part Number	Description	Use Code	Qty
W10	**803783–05**	**AC Receptacle Wire Harness**		REF
2	200267–026	**Terminal**, receptacle, insulated, 22–18 AWG		1
3	201535–084	**Wire**, semirigid, PVC, 300V, 18 AWG, blue		A/R



W10

Figure 5–23 AC Receptacle Wire Harness

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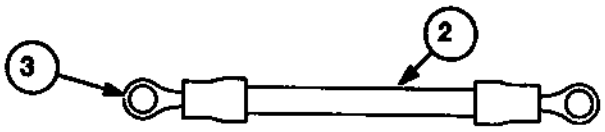
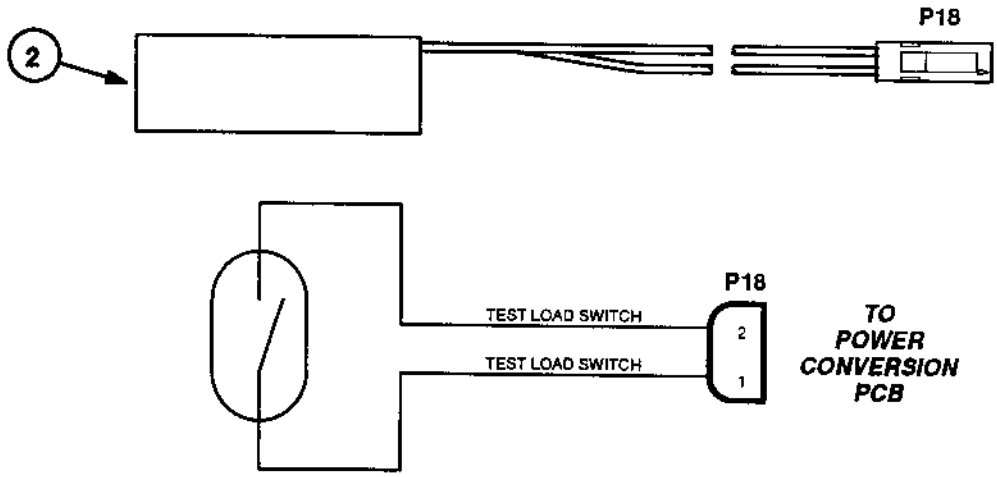
5–24 Ref	Part Number	Description	Use Code	Qty
W11	803783–06	**Test Load Contact/Resistor Wire Harness**		REF
2	202190–000	**Cable**, high voltage, UL/CSA, 10kV, 0.0312 OD		AR
3	200276–211	**Terminal**, lug, 22–16 AWG		2



W11

Figure 5–24 Test Load Contact/Resistor Wire Harness

5–25 Ref	Part Number	Description	Use Code	Qty
W12	803783–07	**Power Conversion PCB/Reed Assembly Wire Harness**		REF
P18	202125–024	**Receptacle**, 2 contact, 26–22 AWG		1
2	808060–00	**Reed Assembly**, magnetic		1



W12

Figure 5–25 Power Conversion PCB/Reed Assembly Wire Harness

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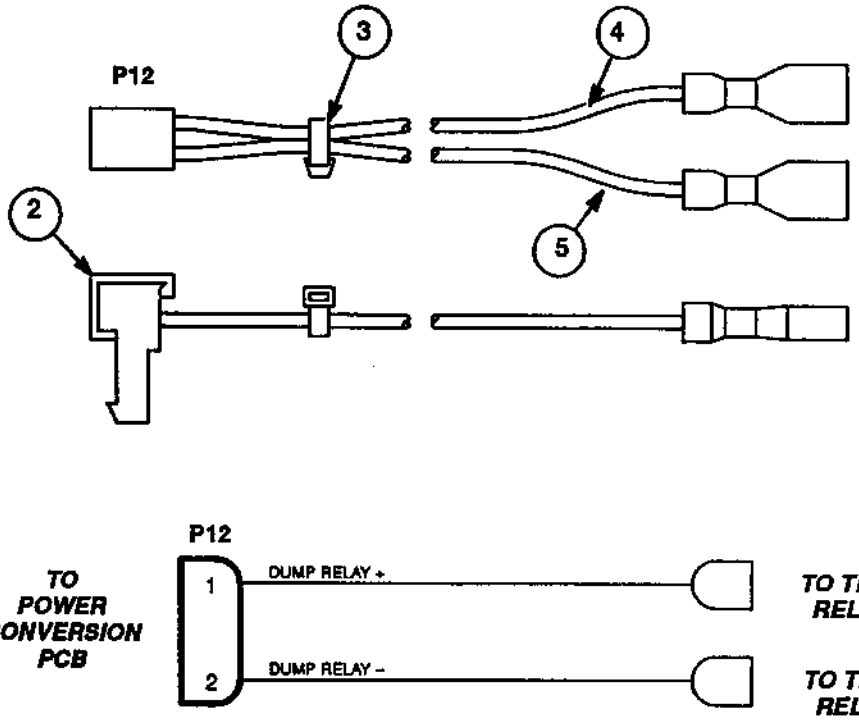
5–26 Ref	Part Number	Description	Use Code	Qty
W13	**803783–08**	**Power Conversion PCB/Dump Relay Wire Harness**		PPF
P12	202151–026	**Connector**, housing, 22 AWG, 2 contact		1
Relay 1,4	200267–020	**Terminal**, receptacle, 22–18 AWG		2
2	202151–113	**Cover**, housing, strain relief, 2 contact		1
3	200536–001	**Retainer**, cable tie, nylon, 0.1 W x 4 L		1
4	201535–021	**Wire**, semirigid, PVC, 300V, 22 AWG, orange		A/R
5	201535–027	**Wire**, semirigid, PVC, 300V, 22 AWG, white		A/R



W13

Figure 5–26 Power Conversion PCB/ Dump Relay Wire Harness

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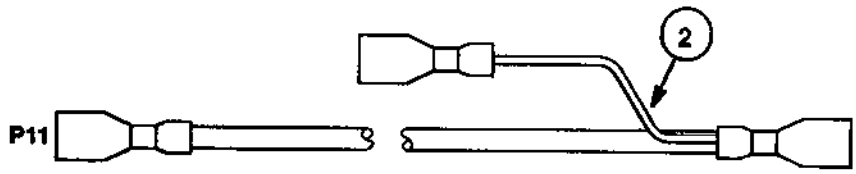
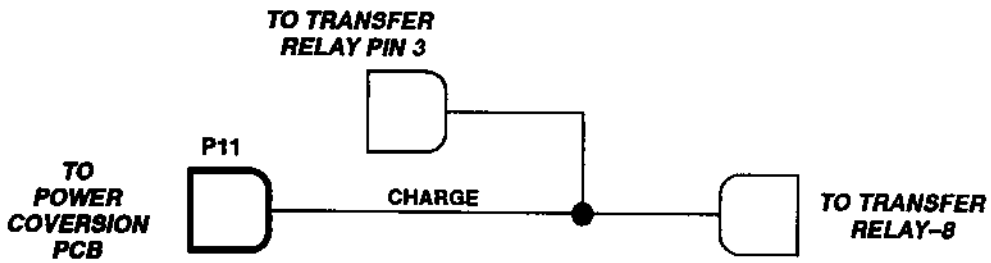
5–27 Ref	Part Number	Description	Use Code	Qty
W14	**803783–09**	**Power Conversion PCB/Charge Relay Negative Wire Harness**		**R...**
P11	200267–020	**Terminal**, receptacle, 22–18 AWG		3
Relay 3, 8		(Same as P11)		
2	201535–026	**Wire**, semirigid, PVC, 300V, 22 AWG, gray		A/R





W14

Figure 5–27 Power Conversion PCB/ Charge Relay Negative Wire Harness

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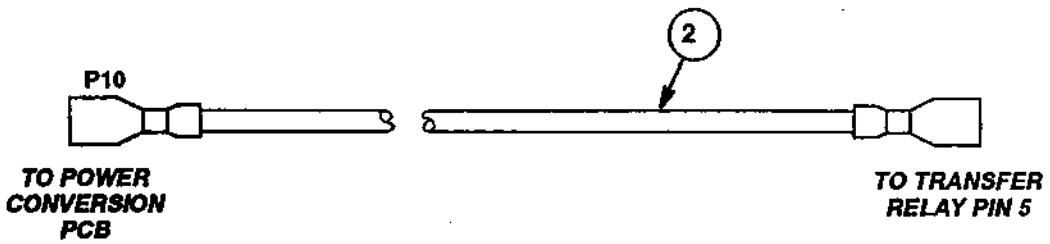
5–28 Ref	Part Number	Description	Use Code	Qty
W15	**803783–10**	**Power Conversion PCB/Charge Relay Positive Wire Harness**		1 EA
P10	200267–020	**Terminal**, receptacle, 22–18 AWG		1
Relay 5		(Same as P10)		
2	202190–000	**Cable**, high voltage, UL/CSA, 10kV, 0.0312 OD		4.0 IN



W15

Figure 5–28 Power Conversion PCB/ Charge Relay Positive Wire Harness

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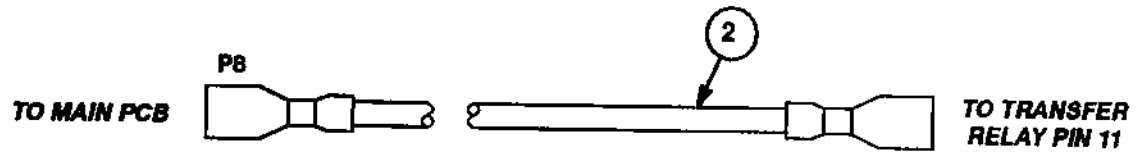
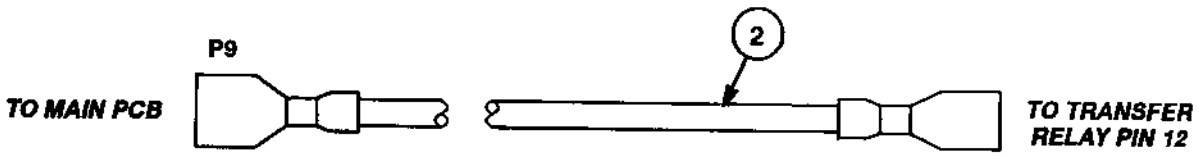
5–29 Ref	Part Number	Description	Use Code	Qty
W16	**803783–11**	**Main PCB/Sternum Relay Wire Harness**		REF
P8	200267–020	**Terminal**, receptacle, 22–18 AWG		2
Relay 11		(Same as P8)		
2	202190–000	**Cable**, high voltage, UL/CSA, 10kV, 0.0312 OD		A/R



W16

Figure 5–29 Main PCB/Sternum Relay Wire Harness

5–30 Ref	Part Number	Description	Use Code	Qty
W17	**803783–12**	**Main PCB/Apex Relay Wire Harness**		REF
P9	200267–026	**Terminal**, receptacle, 22–18 AWG		1
Relay 12	200267–020	**Terminal**, receptacle, 22–18 AWG		1
2	202190–000	**Cable**, high voltage, UL/CSA, 10kV, 0.0312 OD		A/R



W17

Figure 5–30 Main PCB/Apex Relay Wire Harness

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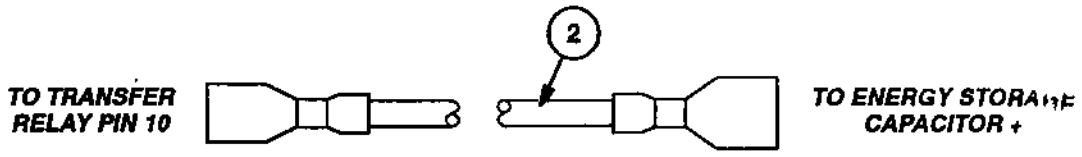
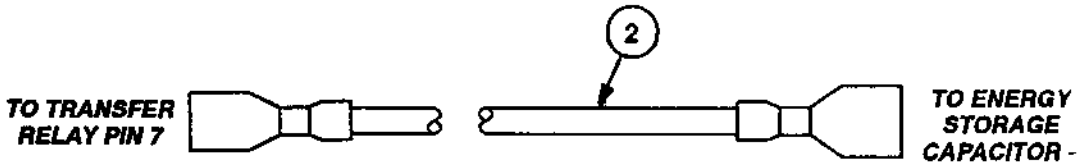
5–31 Ref	Part Number	Description	Use Code	Qty
W18	803783–13	Storage Capacitor Positive/Relay Wire Harness		REF
Relay 10	200267–020	Terminal, receptacle, 22–18 AWG, 0.187		1
CAP+	200267–026	Terminal, receptacle, 22–18 AWG, 0.250		1
2	202190–000	Cable, high voltage, UL/CSA, 10kV, 0.0312 OD		A/R



W18

Figure 5–31 Storage Capacitor Positive/Relay Wire Harness

5–32 Ref	Part Number	Description	Use Code	Qty
W19	803783–14	Storage Capacitor Negative/Relay Wire Harness		REF
Relay 7	200267–020	Terminal, receptacle, 22–18 AWG, 0.187		1
CAP–	200267–026	Terminal, receptacle, 22–18 AWG, 0.250		1
2	202190–000	Cable, high voltage, UL/CSA, 10kV, 0.0312 OD		A/R



W19

Figure 5–32 Storage Capacitor Negative/Relay Wire Harness

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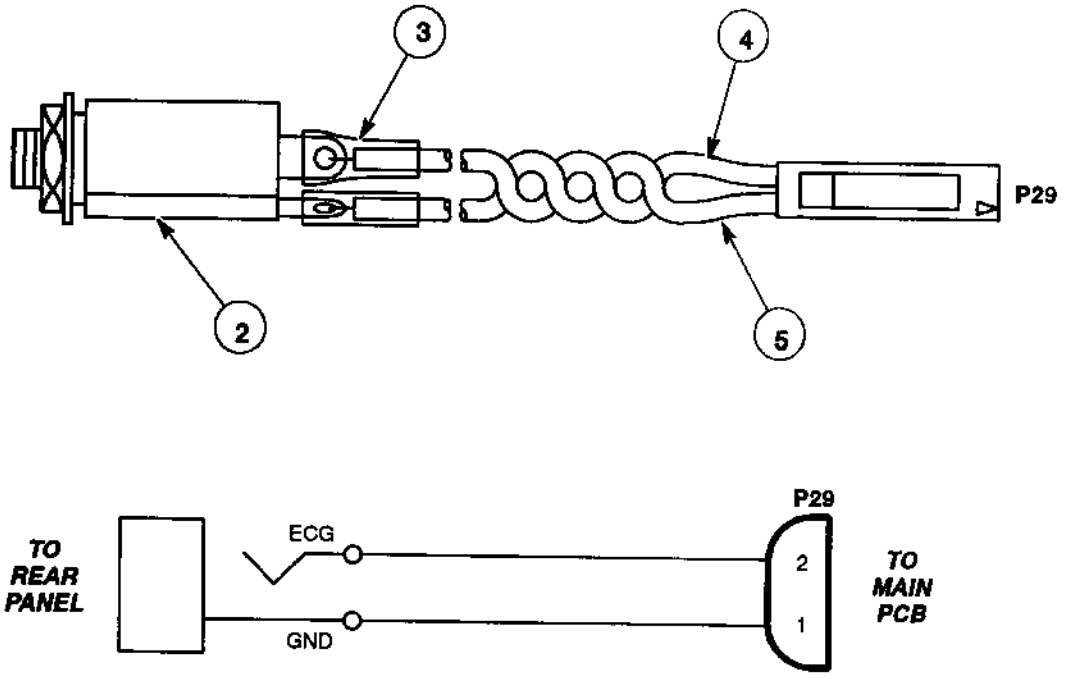
5–33 Ref	Part Number	Description	Use Code
W20	**803783–15**	**ECG Out Wire Harness**	
P29	202125–024	**Receptacle**, 2 contact	
2	200317–002	**Connector**, phone jack	
3	200283–018	**Tubing**, heat shrink, black, 0.187 ID	
4	201535–021	**Wire**, 300V, 22 AWG, orange	
5	201535–027	**Wire**, 300V, 22 AWG, white	



W20

Figure 5–33 ECG Out Wire H...

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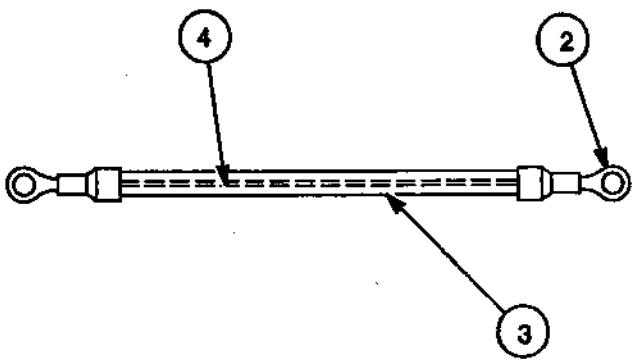
5–34 Ref	Part Number	Description	Use Code	Qty
W21	803783–19	**Recorder/Bracket Ground Wire Harness**		REF
2	200276–209	**Terminal**, lug, ring, #10		1
3	201756–010	**Tubing**, PVC, clear, size 12		A/R
4	201535–023	**Wire**, semirigid, PVC, 300V, AWG 22, green		A/R



W21

Figure 5–34 Recorder/Bracket Ground Wire Harness

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5–35 Ref	Part Number	Description	Use Code	Qty
	803747–00	**Defibrillation Adapter**, English, Domestic	A	Ref
	803747–01	**Defibrillation Adapter**, French, International	B	Ref
	803747–02	**Defibrillation Adapter**, German, International	C	Ref
	803747–03	**Defibrillation Adapter**, Spanish, International	D	Ref
	803747–04	**Defibrillation Adapter**, Spanish, Domestic	E	Ref
	803747–05	**Defibrillation Adapter**, French, Domestic	F	Ref
	803747–06	**Defibrillation Adapter**, French, CSA	G	Ref
	803747–07	**Defibrillation Adapter**, English, CSA	H	Ref
	803747–08	**Defibrillation Adapter**, English, UK	I	Ref
	803747–09	**Defibrillation Adapter**, Portuguese	J	Ref
	803747–10	**Defibrillation Adapter**, Italian	K	Ref
	803747–11	**Defibrillation Adapter**, Swedish	L	Ref
S3	803781–01	**Switch**, test load		1
W1	803774–03	**Test Load High Voltage Wire Harness** (pg. 5–89)		1
W2	803774–04	**Test Load High Voltage Wire Harness** (pg. 5–89)		1
W3	803774–05	**Pushbutton Switch Wire Harness** (pg. 5–90)		1
W4	803756–09	**High Voltage Connector Cable Assembly** (pg. 5–91)		1
2	803738–11	**Case**, front		1
3	803751–01	**Case**, rear		1
4	803750–00	**Cover**, interior		1
5	803765–00	**Insulator**, connector pin electrode		1
6	803752–31	**Label**, defibrillation adapter, English	A,H,I	1
	803752–33	**Label**, defibrillation adapter, French	B,F,G	1
	803752–35	**Label**, defibrillation adapter, German	C	1
	803752–37	**Label**, defibrillation adapter, Spanish	D,E	1
	803752–38	**Label**, defibrillation adapter, Portuguese	J	1
	803752–40	**Label**, defibrillation adapter, Italian	K	1
	803752–42	**Label**, defibrillation adapter, Swedish	L	1
7	803731–04	**Label**, serial number, English, Domestic (not shown, used on item 2)	A	
	803731–05	**Label**, serial number, French, International	B	1
	803731–06	**Label**, serial number, German, International	C	1
	803731–07	**Label**, serial number, Spanish, International	D	1
	803731–08	**Label**, serial number, Spanish, Domestic	E	1
	803731–09	**Label**, serial number, French, Domestic	F	1
	803731–10	**Label**, serial number, French, CSA	G	1
	803731–11	**Label**, serial number, English, CSA	H	1
	803731–12	**Label**, serial number, English, UK	I	1
	803731–26	**Label**, serial number, Portuguese	J	1

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5–35 Ref	Part Number	Description	Use Code	Qty
	803731–29	**Label**, serial number, Italian	K	1
	803731–32	**Label**, serial number, Swedish	L	1
8	805532–01	**Fastener Plate**, switch, test load		1
9	201508–003	**Nut**, lock, kep, 6–32		4
10	803780–02	**Pin**, connector, electrode		1
11	803725–02	**Plate**, test load		1
	802935–08	**Pushbutton**, paddle, discharge, Domestic	A,E–H	1
	802935–09	**Pushbutton**, paddle, discharge, International	B–D,I–L	1
12	200536–001	**Retainer**, cable tie, nylon, 0.10 W x 4 L (not shown, used on W3)		1
13	200530–002	**Retainer**, clamp, cable		1
14	202039–000	**Retainer**, wire, adhesive mount (not shown, used on W3)		1
15	202253–506	**Screw**, pan head, 2–56 x 0.375 L		1
16	201874–001	**Screw**, pan head, 6–32 x 0.250 L		1
17	201873–236	**Screw**, pan head, 6–32 x 0.750 L		4
18	201625–173	**Spring**, compression, 0.240 OD, 0.562 L		1
19	200283–003	**Tubing**, heatshrink, red 0.125 ID (not shown, used on S3)		AR
20	201575–004	**Washer**, lock, #6 x 0.288 OD, 0.018 T		1

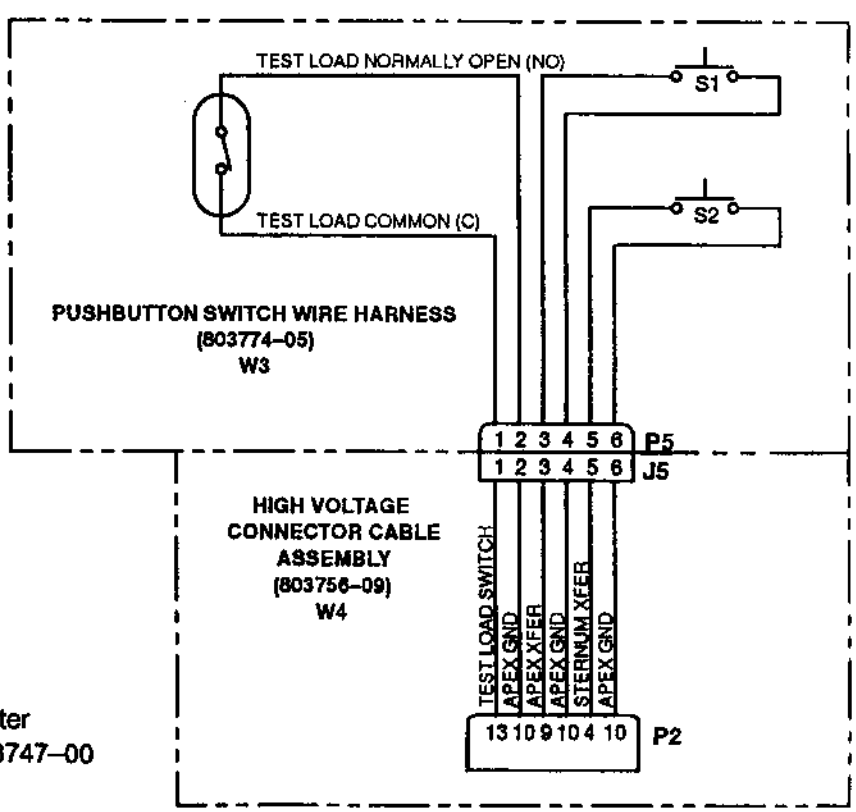

Figure 5–35 Defibrillation Adapter
Part Number 803747–00
(Sheet 1 of 2)

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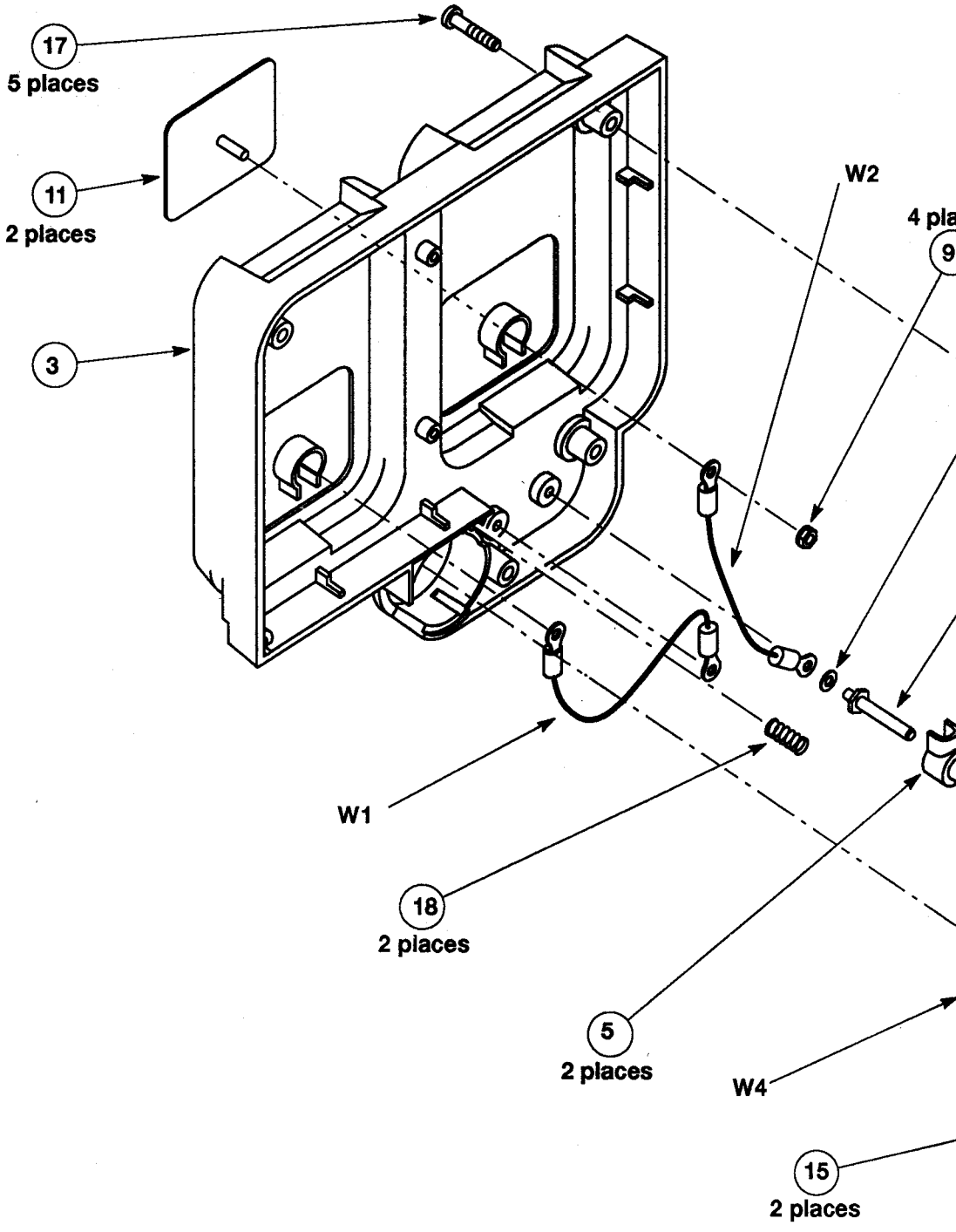
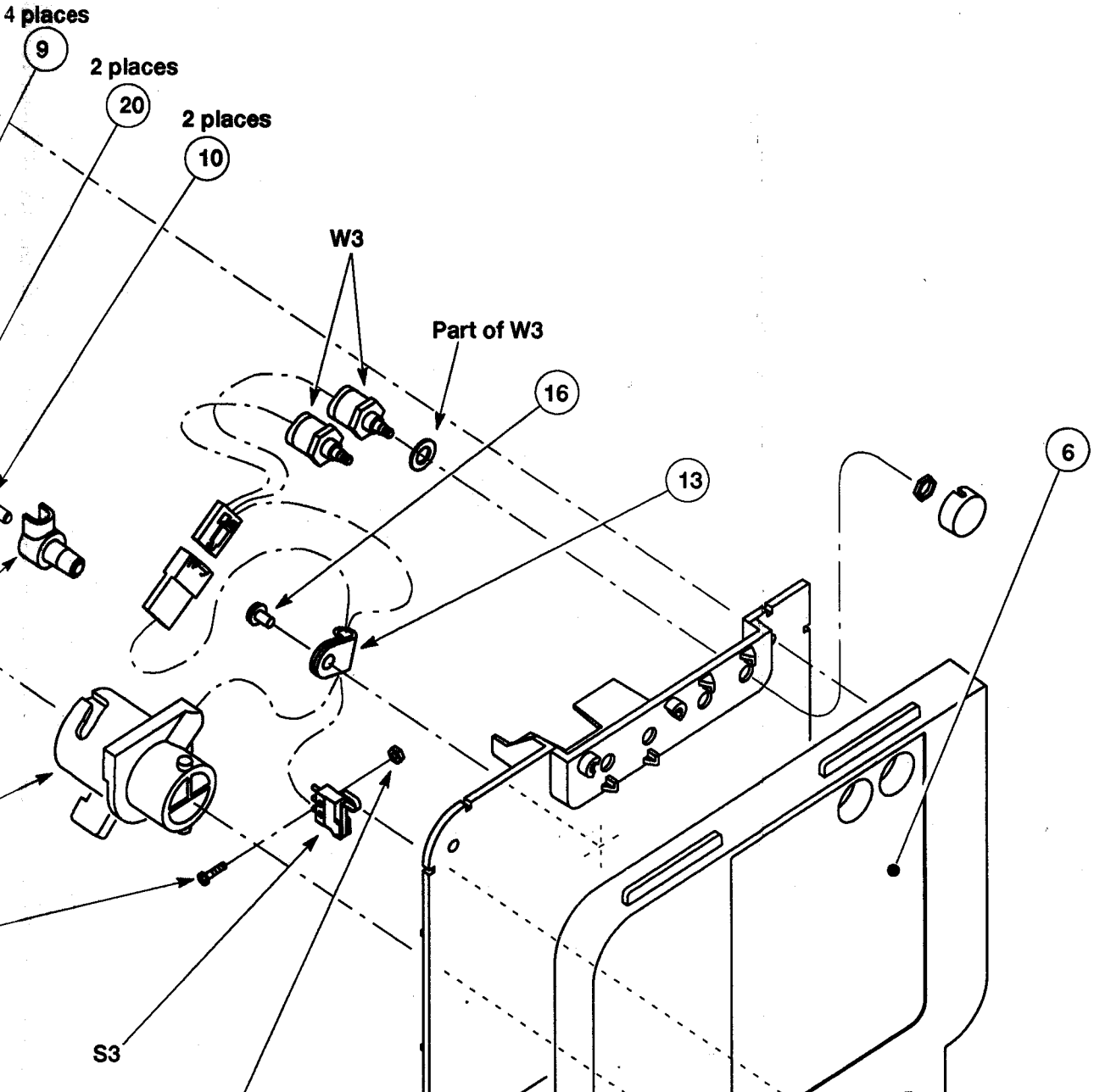
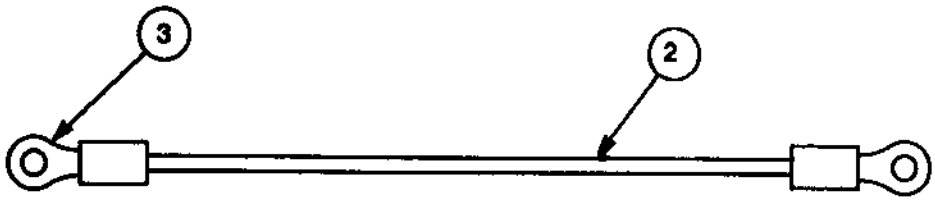

17
5 places
11
2 places
3
W2
4 pla
9
W1
18
2 places
5
2 places
W4
15
2 places


4 places
9
2 places
20
2 places
10
W3
Part of W3
16
13
6
S3

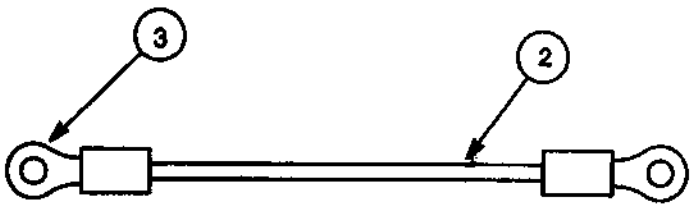
5–36 Ref	Part Number	Description	Use Code	Qty
W1	803774–03	**Test Load High Voltage Wire Harness**		PPF
2	202190–000	**Cable**, high voltage, UL/CSA, 10kV, 0.0312 OD		...
3	200276–211	**Terminal**, lug, 22–16 AWG		2



W1

Figure 5–36 Test Load High Voltage Wire Harness

5–37 Ref	Part Number	Description	Use Code	Qty
W2	803774–04	**Test Load High Voltage Wire Harness**		PPF
2	202190–000	**Cable**, high voltage, UL/CSA, 10kV, 0.0312 OD		...
3	200276–211	**Terminal**, lug, 22–16 AWG		2



W2

Figure 5–37 Test Load High Voltage Wire ...

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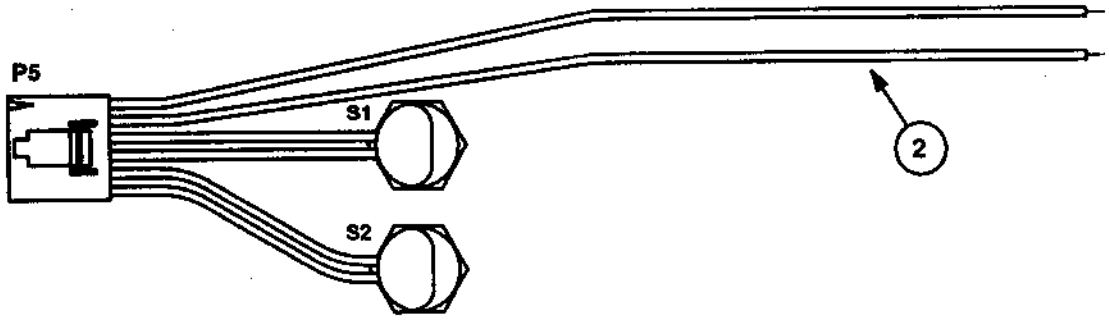
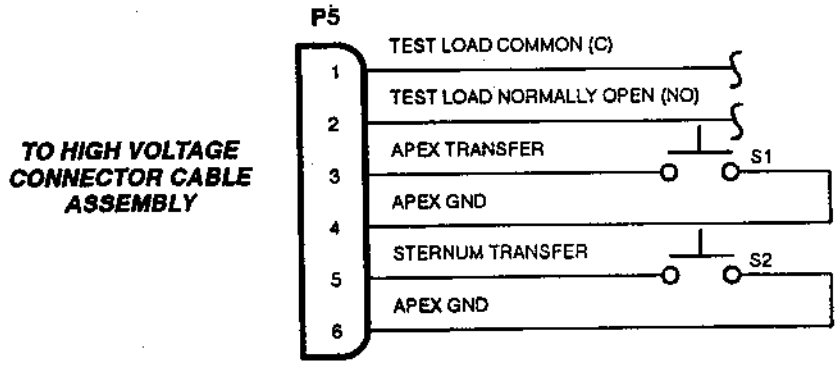
5–38 Ref	Part Number	Description	Use Code	Qty
W3	803774–05	**Pushbutton Switch Wire Harness**		REF
P5	202125–028	**Receptacle Assembly**, polarized, latching, 6 contact		1
S1,S2	804697–04	**Switch**, pushbutton, SPST		2
2	201535–027	**Wire**, semirigid, PVC, 300V, AWG 22, white		AR





W3

Figure 5–38 Pushbutton Switch Wire Harness

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5–39 Ref	Part Number	Description	Use Code	Qty
W4	803756–09	High Voltage Connector Cable Assembly		1

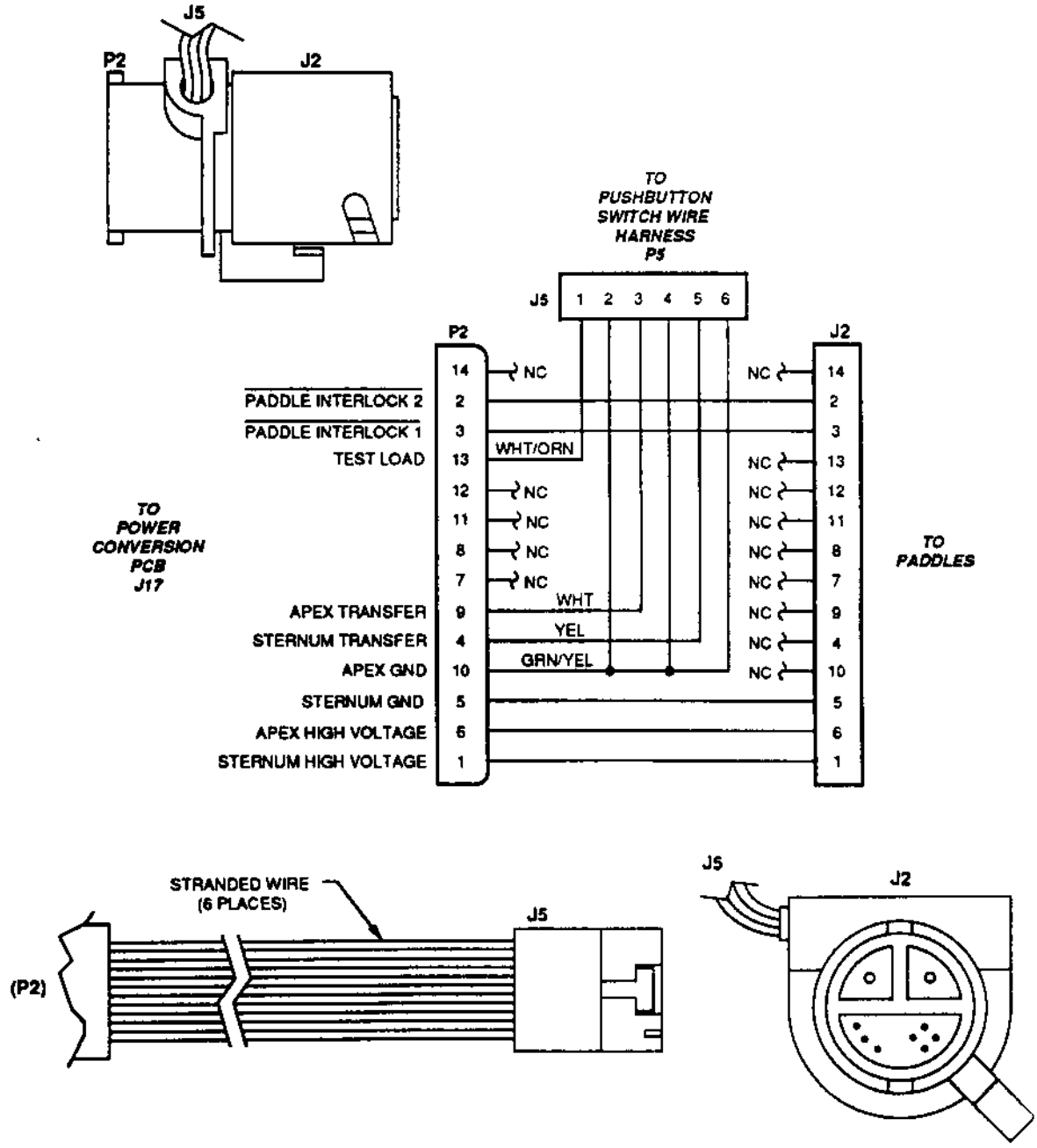

Figure 5–39 High Voltage Connector Cable Assembly

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Component Reference 6

Introduction

This section contains component diagrams for integrated circuits selected from the PCB assembly schematics. Each figure contains some or all of the following information as an aid in circuit analysis and troubleshooting:

- Pin Configuration
- Function Table
- Block Diagram.

Caution

Potential Component Damage. Use special handling procedures on page 4–4 when handling static sensitive devices (SSDs). SSDs are identified in Table 6-1 with this symbol:

Table 6–1 Component Reference Diagrams

Assembly	Ref Des.	IC Number	Type	Fig No.	Page No.
Display (A4)	U101	TDA1170N	Deflection Circuit	6–9	6-7
	U201	TL494CN	Voltage Regulator	6–27	6-15
Interconnect (A5)	U1 ⚠	74HC238	Decoder	6–8	6-6

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Table 6–1 Component Reference Diagrams

Assembly	Ref Des.	IC Number	Type	Fig No.	Page No.
Main (A1)	U1,U30 ⚠	63B03Y	Microprocessor	6–17	
	U3 ⚠		Gate Array, Recorder	6–16	
	U4 ⚠	4040	Counter	6–5	
	U5	3525A	Modulator, Pulse–Width	6–18	
	U10	NCM031C	Oscillator	6–21	
	U11,U12, U15 ⚠	74HCT244	Buffer	6–1	
	U13,U21, U28A ⚠	HM62256LP–12	Static RAM, 32k x 8	6–24	
	U22 ⚠	27C256	EPROM	6–10	
	U16 ⚠	74HC74	Flip–Flop, D–Type	6–11	
	U19,U20 ⚠	74HCT374	Flip–Flop, D–Type	6–12	
	U25 ⚠	74HCT138	Decoder	6–7	
	U26 ⚠	74HC4538	Multivibrator	6–20	
	U28B	DS1242Y	Clock, Real–Time	6–2	
	U29 ⚠		Gate Array, Display	6–15	
	U31 ⚠	74HC221	Multivibrator	6–19	
	U32 ⚠	74HC161	Counter	6–6	
	U33 ⚠	74HC174	Flip–Flop, D–Type	6–13	
	U36 ⚠	74HC76	Flip–Flop, J–K	6–14	
	U40,U43 ⚠	DG307, DG302	Switch, Analog	6–25	
	U41,U42 ⚠	DG509	Switch, Analog	6–26	
Power Conversion (A3)	U3	3843	Regulator, Pulse–Width	6–23	
	U9 ⚠	TLC1541	Converter, A/D	6–3	
	U18 ⚠	7541	Converter, D/A	6–4	
	U19,U20 ⚠	74HC164	Register, Shift	6–22	

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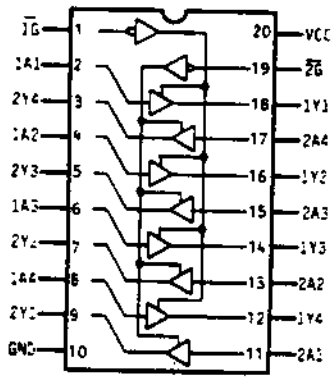
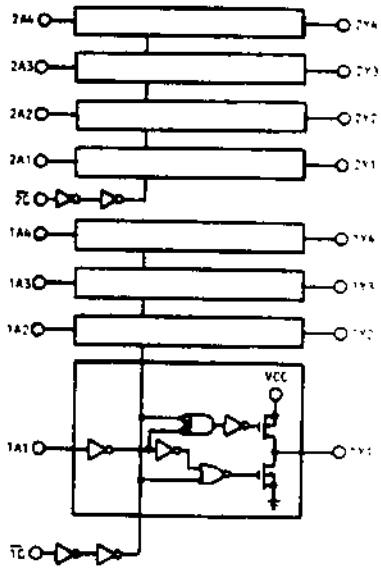
TYPE	IC NUMBER	LOCATION	REF. DE...
Buffer	74HCT244	Main (A1)	U11, U1... U1...



CONNECTION DIAGRAM



FUNCTIONAL DIAGRAM

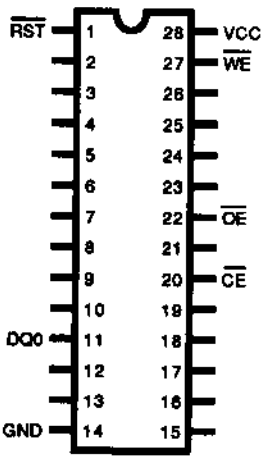
1G̅	1A	1Y	2G̅	2A	2Y
L	L	L	L	L	L
L	H	H	L	H	H
H	L	Z	H	L	Z
H	H	Z	H	H	Z

H = High level
L = Low level
Z = High impedance output

FUNCTION TABLE

Figure 6–1 Buff...

TYPE	IC NUMBER	LOCATION	REF. DE...
Clock, Real–Time	DS1216C	Main (A1)	U28B



NOTE: ALL PINS PASS THROUGH EXCEPT PINS 20 AND 28

PIN CONFIGURATION

Figure 6–2 Real–Time Clo...

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Type	IC Number	Location	Ref Des
Converter, A/D ⚠	TLC1541	Power Conversion (A3)	U5

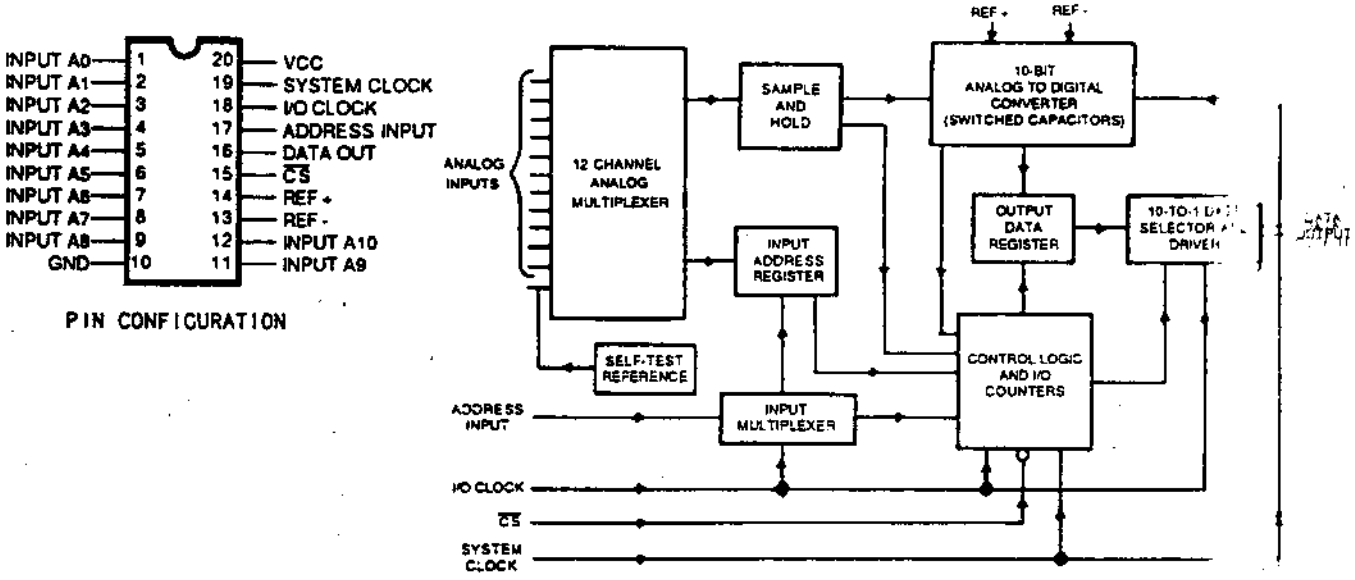

Figure 6–3 A/D Converter

Type	IC Number	Location	Ref Des
Converter D/A ⚠	7541	Power Conversion (A3)	U16

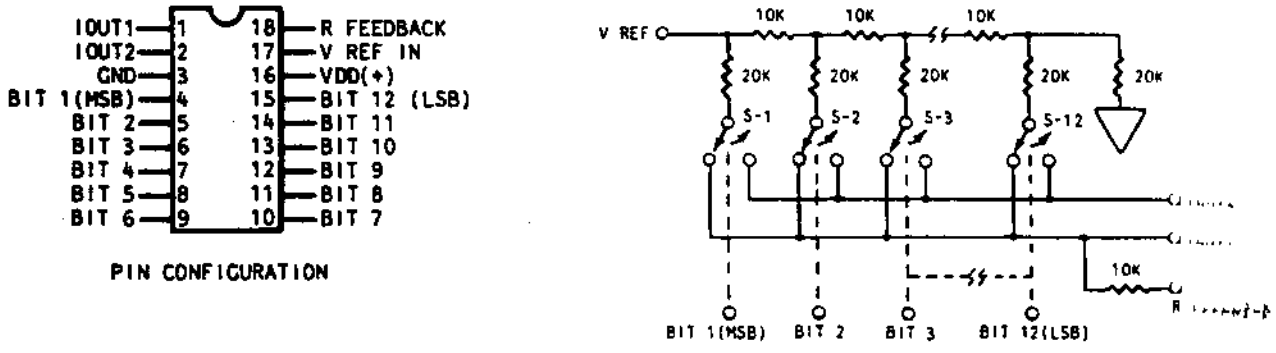

Figure 6–4 D/A Converter

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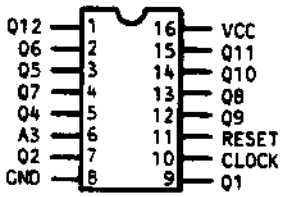
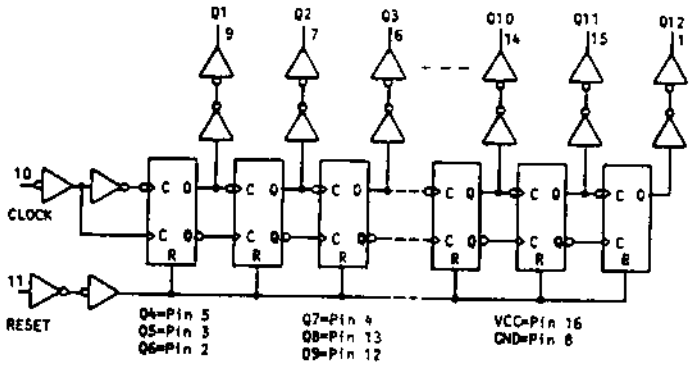
Type	IC Number	Location	Ref. De...
Counter ⚠	4040	Main (A1)	U4



PIN CONFIGURATION



FUNCTIONAL DIAGRAM

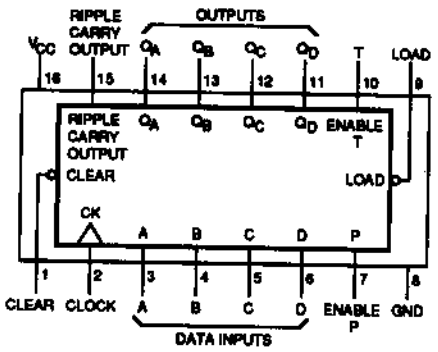
CLOCK	RESET	OUTPUT STATE
⌐	0	No Change
⌐	0	Advance to next state
X	1	All Ouputs are low

X = Don't Care

FUNCTION TABLE

Figure 6–5 Counte...

Type	IC Number	Location	Ref. Des
Counter ⚠	74HC161	Main (A1)	U32

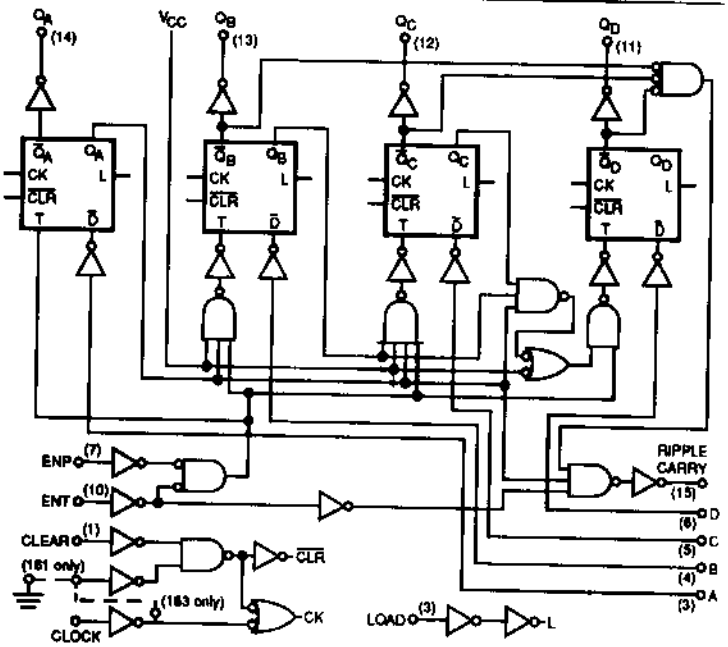


CONNECTION DIAGRAM

CLK	CLR	ENP	ENT	Load	Function
X	L	X	X	X	Clear
X	H	H	L	H	Count & RC disabled
X	H	L	H	H	Count disabled
X	H	L	L	H	Count & RC disabled
↑	H	X	X	L	Load
↑	H	H	H	H	Increment counter

H = high level L = low level
X = don't care ↑ = low to high transition

FUNCTION TABLE



FUNCTIONAL DIAGRAM

Figure 6–6 Coun...

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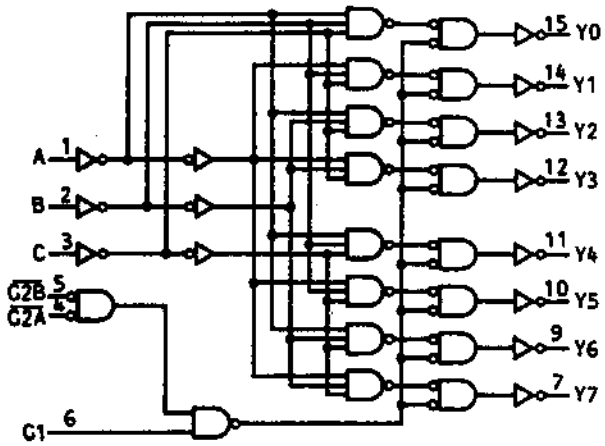
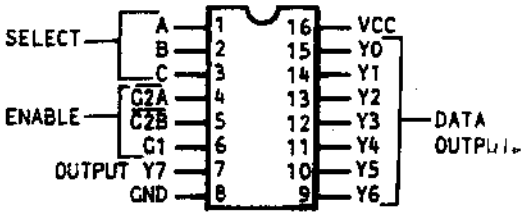
Type	IC Number	Location	Ref Des
Decoder	74HCT138	Main (A1)	



FUNCTIONAL DIAGRAM



PIN CONFIGURATION

INPUTS					OUTPUTS					
ENABLE		SELECT								
G1	$\overline{G2}$*	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5
X	H	X	X	X	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H
H	L	L	H	H	H	H	H	L	H	H
H	L	H	L	L	H	H	H	H	L	H
H	L	H	L	H	H	H	H	H	H	L
H	L	H	H	L	H	H	H	H	H	H
H	L	H	H	H	H	H	H	H	H	H

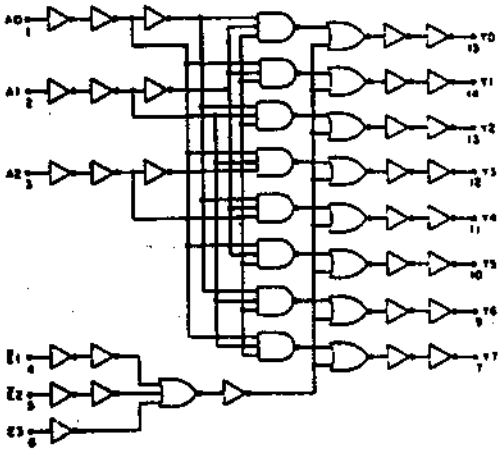
*$\overline{C2} = \overline{C2A} + \overline{C2B}$

H = HIGH LEVEL, L = LOW LEVEL, X = DON'T CARE

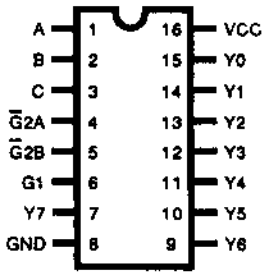
FUNCTION TABLE

Figure 6–7 Decoder

Type	IC Number	Location	Ref Des
Decoder	74HC238	Interconnect (A5)	



FUNCTIONAL DIAGRAM



PIN CONFIGURATION

INPUTS						OUTPUTS						
ENABLE			ADDRESS									
E3	$\overline{E2}$	$\overline{E1}$	A_2	A_1	A_0	Y0	Y1	Y2	Y3	Y4	Y5	Y6
X	X	H	X	X	X	L	L	L	L	L	L	L
L	X	X	X	X	X	L	L	L	L	L	L	L
X	H	X	X	X	X	L	L	L	L	L	L	L
H	L	L	L	L	L	H	L	L	L	L	L	L
H	L	L	L	L	H	L	H	L	L	L	L	L
H	L	L	L	H	L	L	L	H	L	L	L	L
H	L	L	L	H	H	L	L	L	H	L	L	L
H	L	L	H	L	L	L	L	L	L	H	L	L
H	L	L	H	L	H	L	L	L	L	L	H	L
H	L	L	H	H	L	L	L	L	L	L	L	H
H	L	L	H	H	H	L	L	L	L	L	L	L

H = High level, L = low level, X = don't care

FUNCTION TABLE

Figure 6–8 Decoder

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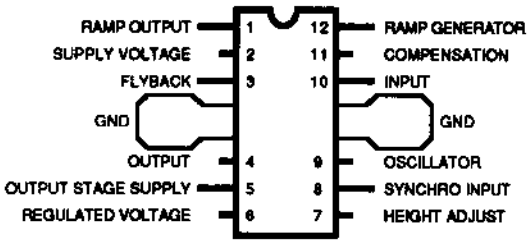
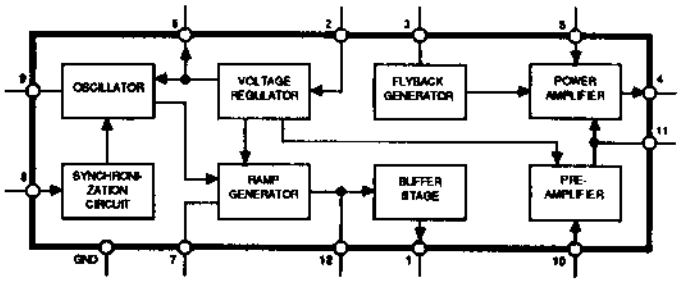
Type	IC Number	Location	Ref. Des
Circuit, Deflection	TDA1170N	Display (A4)	U101



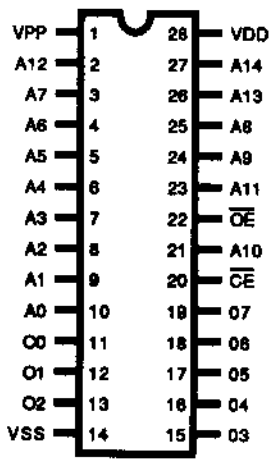
PIN CONFIGURATION



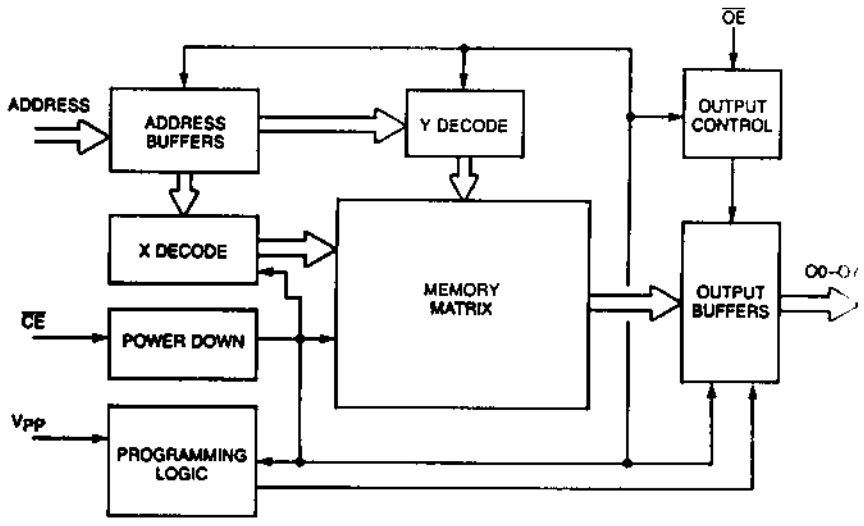
CONNECTION DIAGRAM

Figure 6–9 Deflection Circuit

Type	IC Number	Location	Ref. Des
EPROM ⚠	27C256	Main (A1)	U22



PIN CONFIGURATION



BLOCK DIAGRAM

Figure 6–10 EPROM

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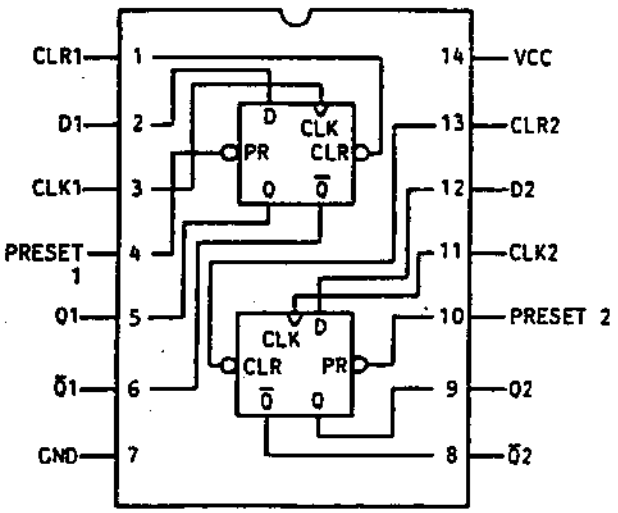
TYPE	IC NUMBER	LOCATION	REF. DES.
Flip–Flop, D–Type ⚠2	74HC74	Main (A1)	U16



CONNECTION DIAGRAM

INPUTS				OUTPUTS	
PR	CLR	CLK	D	Q	Q̄
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H*	H*
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q0	Q̄0

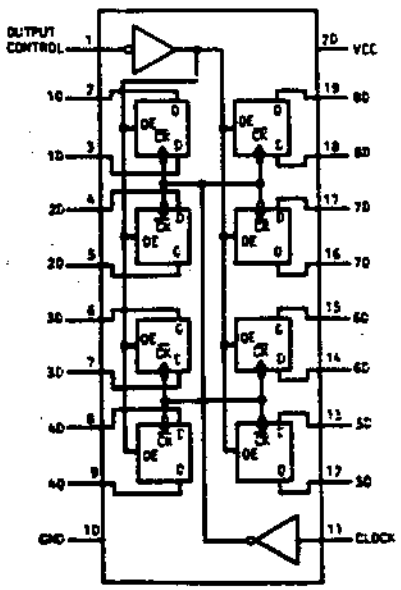
H = High level
L = Low level
X = Irrelevant
Q0 = The level of Q before the indicated steady-state input conditions were established.

*This configuration is nonstable; that is, it will not persist when preset and clear inputs return to their inactive (high) level.

FUNCTION TABLE

Figure 6–11 D–Type Flip–Flop

TYPE	IC NUMBER	LOCATION	REF. DES.
Flip–Flop, D–Type ⚠2	74HCT374	Main (A1)	U19, U30



CONNECTION DIAGRAM

OUTPUT CONTROL	CLOCK	DATA	OUTPUT
L	↑	H	H
L	↑	L	L
L	L	X	Q0
H	X	X	Z

H = HIGH LEVEL
L = LOW LEVEL
↑ = TRANSITION FROM LOW-TO-HIGH
Z = HIGH IMPEDANCE STATE
Q0 = THE LEVEL OF THE OUTPUT BEFORE STEADY STATE INPUT CONDITIONS WERE ESTABLISHED

FUNCTION TABLE

Figure 6–12 D–Type Flip–Flop

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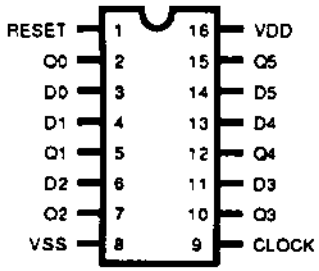
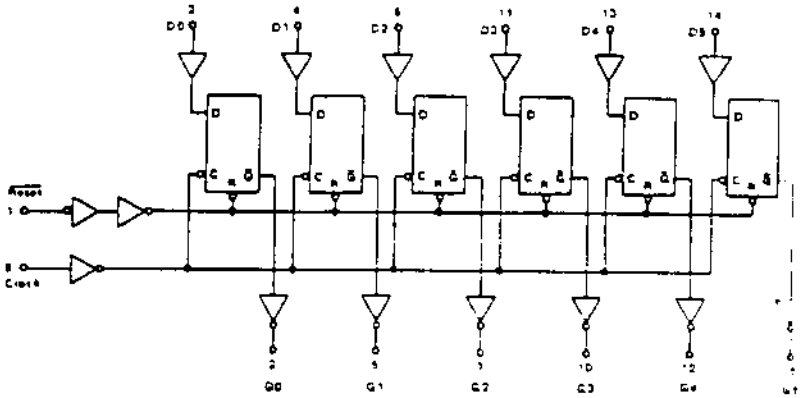
Type	IC Number	Location	Ref. Des
Flip–Flop, D–Type	74HC174	Main (A1)	U33



PIN CONFIGURATION



FUNCTIONAL DIAGRAM

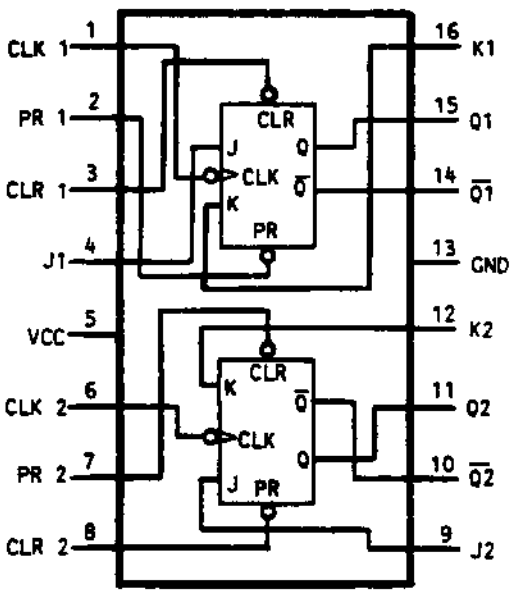
INPUTS			OUTPUT
Clock	Data	Reset	Q
↑	0	1	0
↑	1	1	1
↓	X	1	Q (No Change)
X	X	0	0

X = Don't Care

FUNCTION TABLE

Figure 6–13 D–Type Flip–Flop

Type	IC Number	Location	Ref. Des.
Flip–Flop, J–K	74HC76	Main (A1)	U36



CONNECTION DIAGRAM

INPUTS					OUTPUTS	
PR	CLR	CLK	J	L	Q	Q̄
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	L*	L*
H	H	↓	L	L	Q0	Q̄0
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	TOGGLE	
H	H	H	X	X	Q0	Q̄0

*This is an unstable condition, and is not guaranteed

FUNCTION TABLE

Figure 6–14 J–K Flip–Flop

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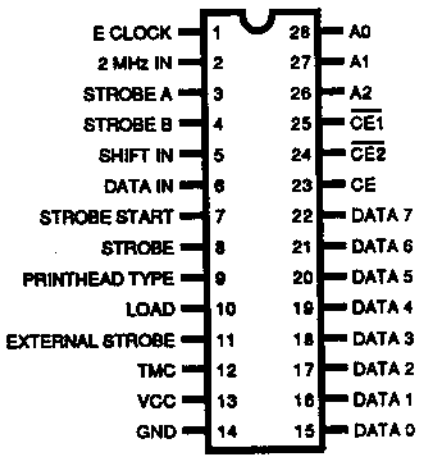
Type	IC Number	Location	Ref. Des
Gate Array, Display ⚠		Main (A1)	U29

PIN CONFIGURATION

	1	2	3	4	5	6	7	8	9	10	11	12
M	NC M-1	NC M-2	NC M-3	VSS M-4	NC M-5	EDAT1 M-6	EDAT3 M-7	EDAT6 M-8	RASTER M-9	VIDEO1 M-10	VSS M-11	NC M-12
M	NC M-1	NC M-2	NC M-3	NC M-4	SXTR2 M-5	EDAT0 M-6	EDAT4 M-7	EDAT7 M-8	VIDEO2 M-9	FRAME M-10	NC M-11	NC M-12
L	NC L-1	NC L-2	NC L-3	NC L-4	VDD L-5	EDAT2 L-6	EDAT5 L-7	VRAMCE L-8	NC L-9	NC L-10	NC L-11	NC L-12
K	NC K-1	VDD K-2	NC K-3	NC K-4						NC K-10	NC K-11	NC K-12
J	AD10 J-1	AD11 J-2	NC J-3								CDAT6 J-11	TMC J-12
H	AD7 H-1	AD8 H-2	AD9 H-3								CDAT3 H-11	CDAT5 H-12
G	VDD G-1	VSS G-2	AD6 G-3				BOTTOM				CDAT0 G-11	CDAT1 G-12
F	AD4 F-1	AD3 F-2	AD5 F-3								FAD3 F-11	FAD4 F-12
E	AD1 E-1	AD0 E-2	AD2 E-3								NC E-11	FAD1 E-12
D	VSS D-1	NC D-2	NC D-3	NC D-4						NC D-10	NC D-11	VDD D-12
C	NC C-1	NC C-2	NC C-3	NC C-4	NC C-5	$\overline{TCLK1}$ C-6	GO C-7	NC C-8	$\overline{TCLK2}$ C-9	NC C-10	NC C-11	NC C-12
B	NC B-1	NC B-2	NC B-3	VDD B-4	$\overline{RESET}$ B-5	CHAR/$\overline{TR}$ B-6	VSS B-7	NC B-8	NC B-9	NC B-10	NC B-11	NC B-12
A	NC A-1	NC A-2	NC A-3	18MHZ A-4	R/$\overline{RETR}$ A-5	$\overline{INCMEM}$ A-6	$\overline{TCLR1}$ A-7	VDD A-8	$\overline{TCLK3}$ A-9	VSS A-10	NC A-11	NC A-12

Figure 6–15 Display Gate Array

Type	IC Number	Location	Ref. Des
Gate Array, Recorder ⚠		Main (A1)	U3



PIN CONFIGURATION

Figure 6–16 Recorder Gate Array

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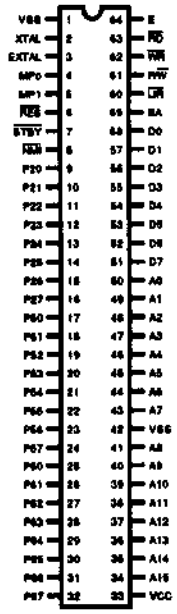
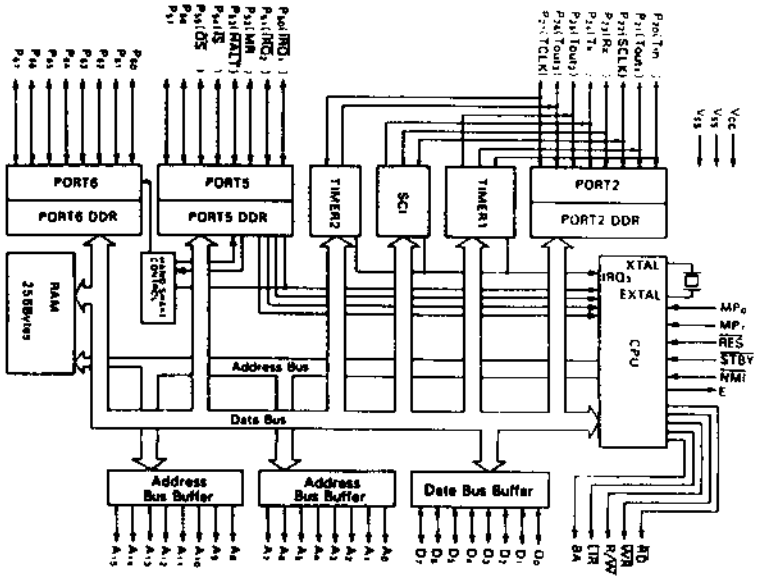
Type	IC Number	Location	Ref. Des.
Microprocessor ▲	63B03Y	Main (A1)	U1, U30



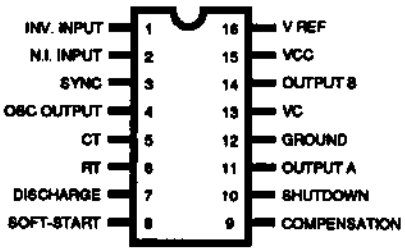
PIN CONFIGURATION



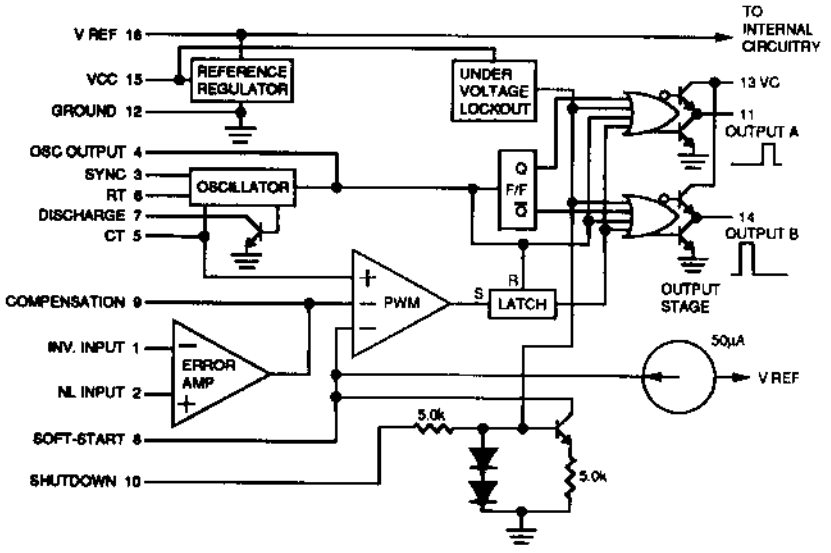
BLOCK DIAGRAM

Figure 6–17 Microprocessor

Type	IC Number	Location	Ref. Des.
Modulator, Pulse–Width	3525A	Main (A1)	U5



PIN CONFIGURATION



FUNCTIONAL DIAGRAM

Figure 6–18 Pulse–Width Modulator

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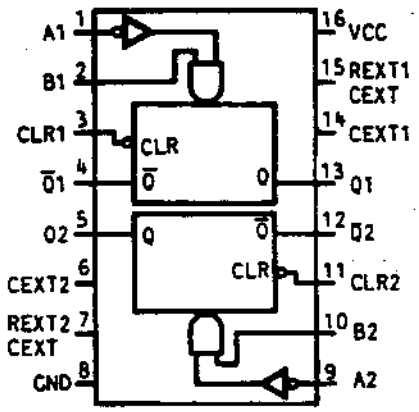
Type	IC Number	Location	Ref. Des
Multivibrator	74HC221	Main (A1)	U31



CONNECTION DIAGRAM

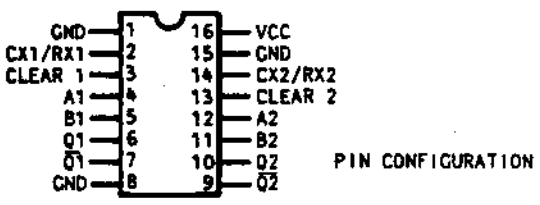
INPUTS			OUTPUTS	
CLEAR	A	B	Q	$\overline{Q}$
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↓	⊓	⊔
H	↓	H	⊓	⊔
↓	L	H	⊓	⊔

H = HIGH LEVEL
L = LOW LEVEL
↓ = TRANSITION FROM LOW TO HIGH
↑ = TRANSITION FROM HIGH TO LOW
⊓ = ONE HIGH LEVEL PULSE
⊔ = ONE LOW LEVEL PULSE
X = IRRELEVANT

FUNCTION TABLE

Figure 6–19 Multivibrator

Type	IC Number	Location	Ref. Des
Multivibrator	4538	Main (A1)	U26

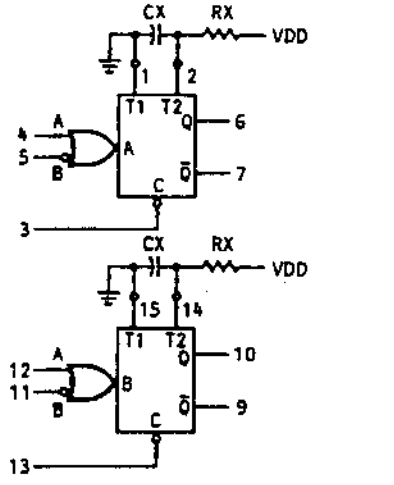


PIN CONFIGURATION

INPUTS			OUTPUTS	
CLR	A	B	Q	$\overline{Q}$
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↓	⊓	⊔
H	↓	H	⊓	⊔

FUNCTION TABLE

H=High Level
L=Low Level
↓=Transition from Low to High
↑=Transition from High to Low
⊓=One High Level Pulse
⊔=One Low Level Pulse
X=Irrelevant



RX AND CS ARE EXTERNAL COMPONENTS

FUNCTIONAL DIAGRAM

Figure 6–20 Multivibrator

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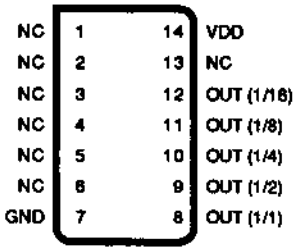
Type	IC Number	Location	Ref. Des
Oscillator	NCM031C	Main (A1)	U10



PIN CONFIGURATION

OUTPUT FREQUENCY (in MHz)

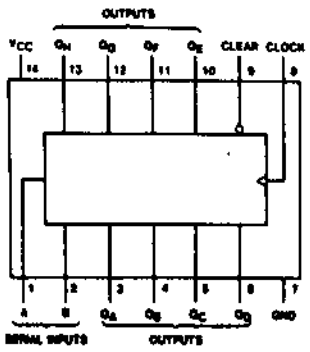
BASE FREQUENCY	OUTPUT DIVIDING RATIOS 1/1	1/2	1/4	1/8	1/16
16.000	16.000	8.000	4.000	2.000	1.000

FREQUENCY TABLE

Figure 6–21 Oscillator

Type	IC Number	Location	Ref. Des
Register, Shift	74HC164	Power Conversion (A3)	U19, U20

CONNECTION DIAGRAM



Inputs				Outputs			
Clear	Clock	A	B	Q_A	Q_B	...	Q_H
L	X	X	X	L	L		L
H	L	X	X	Q_{AO}	Q_{BO}		Q_{HO}
H	↑	H	H	H	Q_{An}		Q_{Gn}
H	↑	L	X	L	Q_{An}		Q_{Gn}
H	↑	X	L	L	Q_{An}		Q_{Gn}

H = High Level (steady state), L = Low Level (steady state)

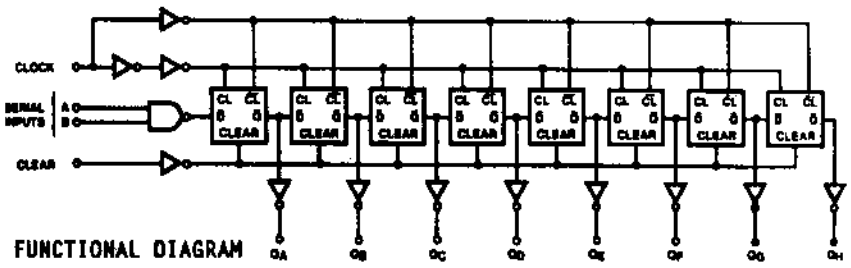
X = Irrelevant (any input, including transitions)

↑ = Transition from low to high level.

Q_{AO}, Q_{BO}, Q_{HO} = The level of Q_A, Q_B, or Q_H, respectively, before the indicated steady state input conditions were established.

Q_{An}, Q_{Gn} = The level of Q_A or Q_G before the most recent ↑ transition of the clock; indicated a one-bit shift.

FUNCTION TABLE



FUNCTIONAL DIAGRAM

Figure 6–22 Shift Register

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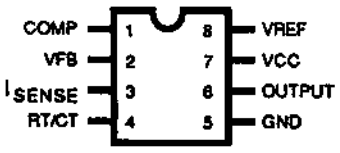
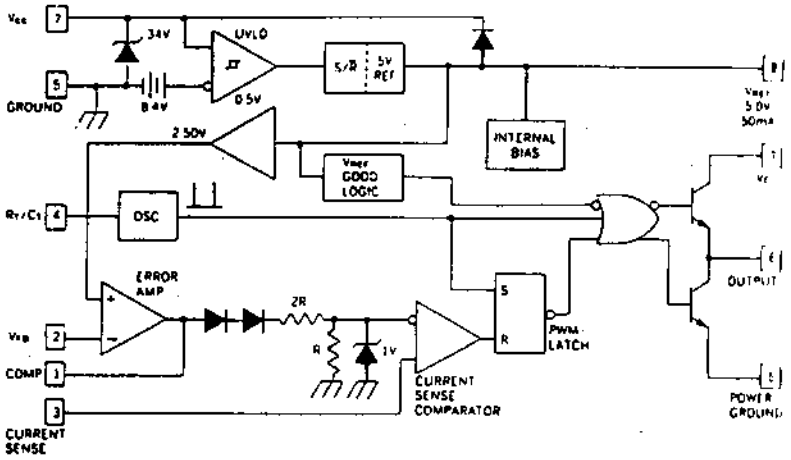
TYPE	IC NUMBER	LOCATION	REF. DES
Regulator, Pulse–Width	3843	Power Conversion (A3)	U3



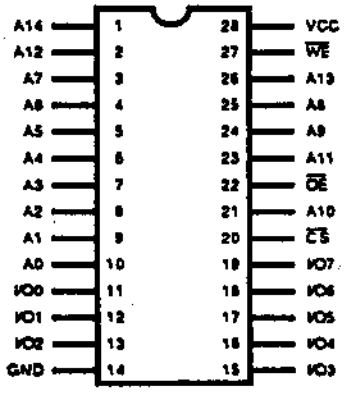
PIN CONFIGURATION



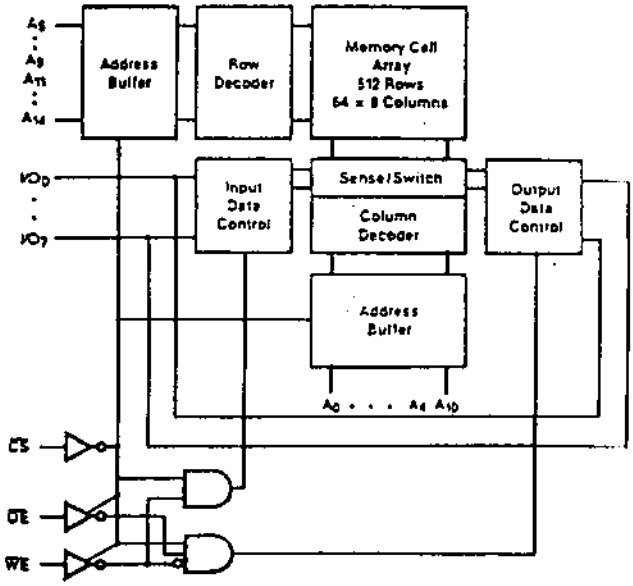
FUNCTIONAL DIAGRAM

Figure 6–23 Pulse–Width Regulator

TYPE	IC NUMBER	LOCATION	REF. DES
Static RAM, 32k x 8 ⚠	HM62256LP–12	Main (A1)	U13, U21 U28A



PIN CONFIGURATION



BLOCK DIAGRAM

Figure 6–24 Static RAM, 32k x 8

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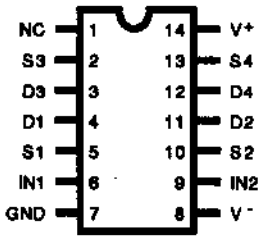
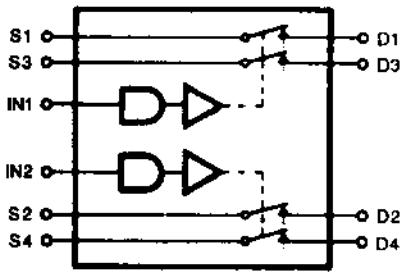
Type	IC Number	Location	Ref. Des
Switch, Analog ⚠	DG302	Main (A1)	U40, U43



PIN CONFIGURATION



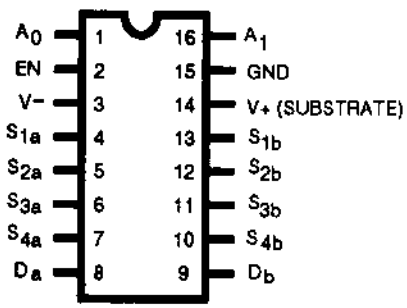
FUNCTIONAL DIAGRAM

LOGIC	SWITCH
0	OFF
1	ON

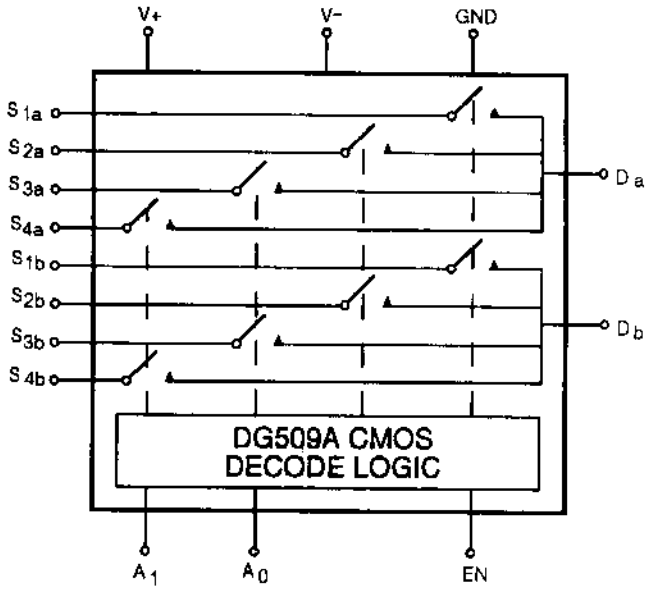
FUNCTION TABLE

Figure 6–25 Analog Switch

Type	IC Number	Location	Ref. Des.
Switch, Analog ⚠	DG509	Main (A1)	U41, U42



PIN CONFIGURATION



FUNCTIONAL DIAGRAM

Figure 6–26 Analog Switch

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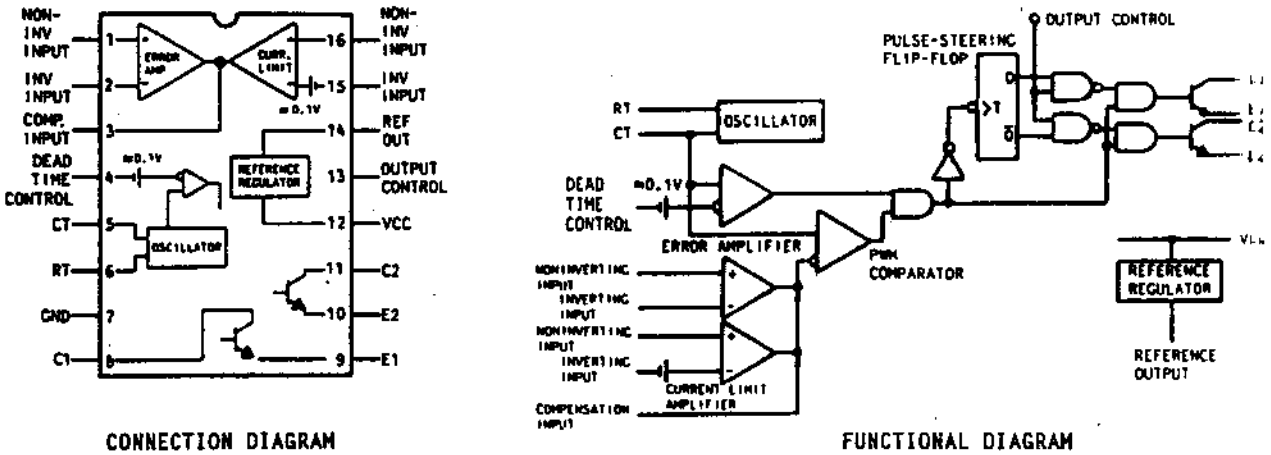
Type	IC Number	Location	Ref. Des
Voltage Regulator	TL494CN	Display Assembly (A4)	U201



CONNECTION DIAGRAM

FUNCTIONAL DIAGRAM

Figure 6–27 Voltage Regulator

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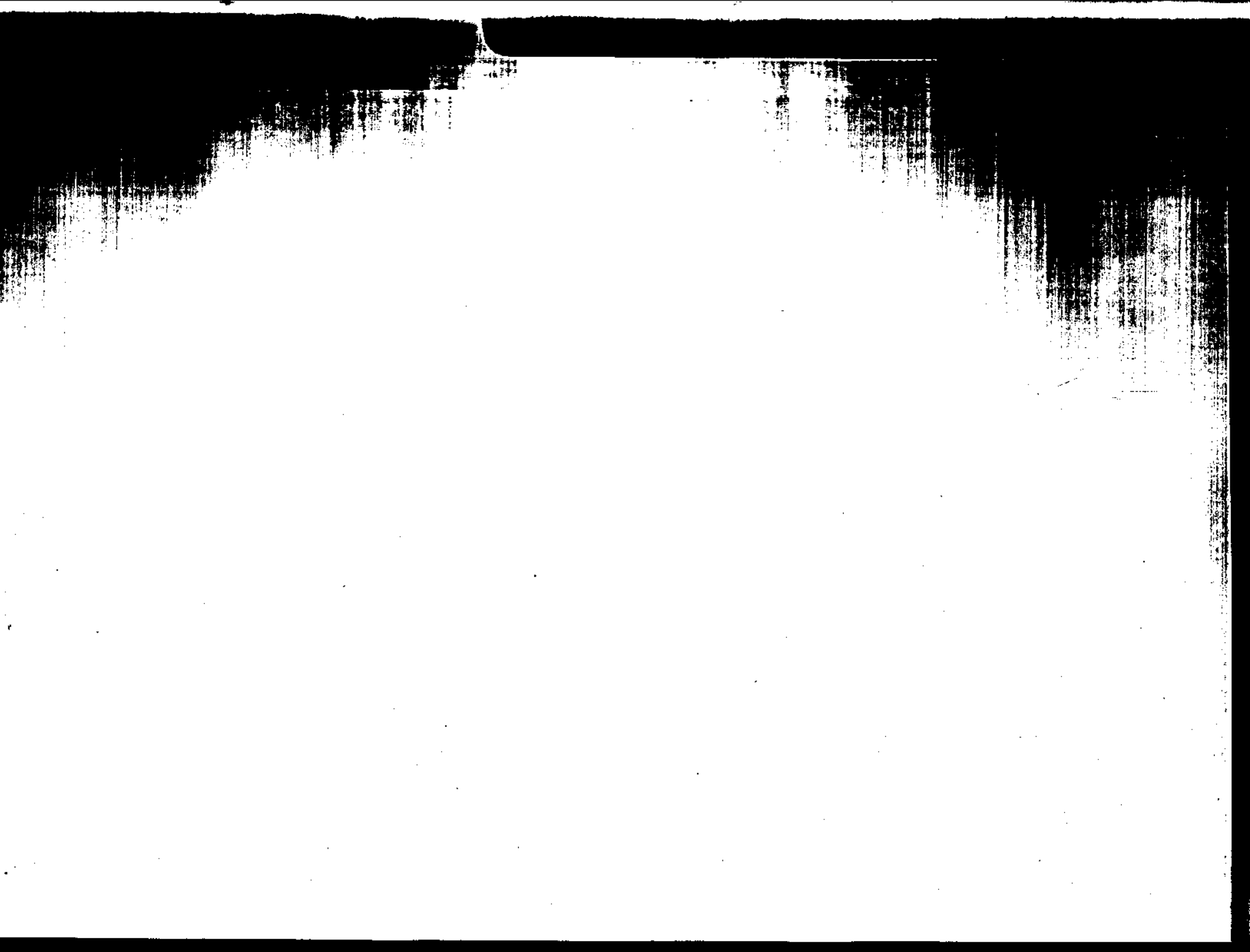

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Parts Lists and Schematics

Introduction

This section includes lists of replaceable parts, component layouts or exploded views, and schematic diagrams for each major assembly of the LIFEPAK 9 defibrillator/monitor. Tables 5–1 and 5–2 list the figure and page number of the major assemblies. Table 5–3 lists standard reference designators for components. Supplies and accessories are listed in Table 5–4.

This section provides the following information:

- Supplies and Accessories
- Reference designators for components
- Replaceable parts
- Component layouts or exploded views
- Schematic diagrams for each major assembly

Parts List

Use parts lists to identify *replaceable* parts. The format for each list is the same:

Ref: This column contains the reference designators or the assigned item number of replaceable parts. Reference designators are abbreviated (see Table 5–2) and are listed alphanumerically by this abbreviation. Assigned item numbers are listed numerically, starting with 2. The number in the heading of this column indicates the figure to which the parts list corresponds.

Part Number: Physio–Control Corporation part number is listed in this column. Part ordering information is provided on page 5–2.

Description: Descriptive information for a part that is used more than once, refers to the initial listing with a "Same as ___" citation. This citation may also list a component value when necessary. Static sensitive devices (SSDs) are identified in this column by this symbol:

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